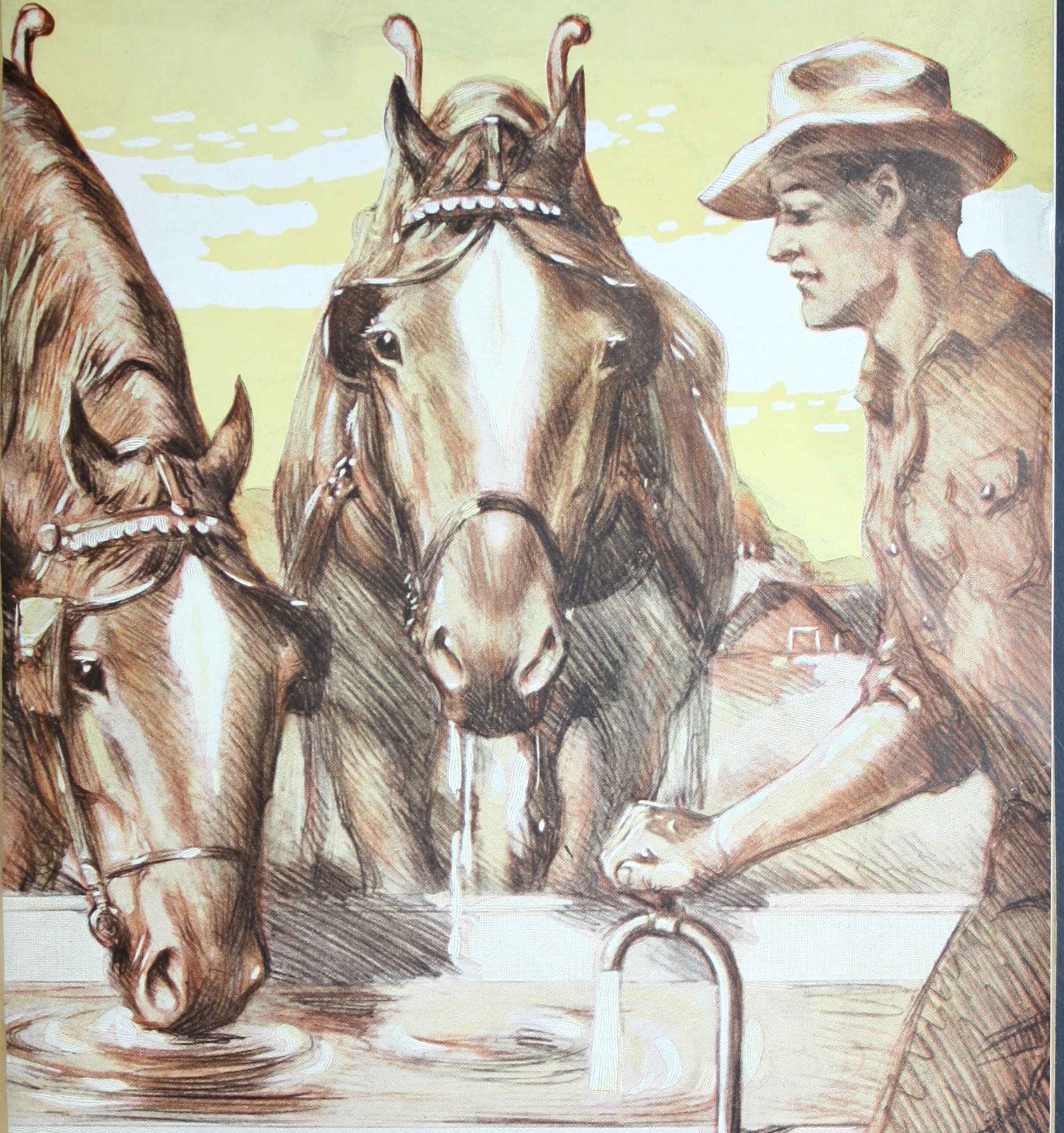
1.6 Humphreys



WATER

Plenty of it-
for man & beast

[redacted] Typical of Many Satisfactory Installations
[redacted] of

HUMPHRYES
***Perfected* Pumps**

"Water, Plenty of it For Man and Beast."

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WATER

the cheapest feed for all live stock

While everyone knows that plenty of pure and fresh water is a necessity to the proper feeding of cattle, very little attention is paid to this most important part of their feeding ration.

For instance, Milk is from 85 to 90% water. The amount of mild produced, therefore, hinges mostly on the amount of water the cow drinks. Higher-producing cows will often drink as much as a barrel of water a day.

Further, it has been asked if increasing the amount of milk produced does not decrease the amount of butter fat. The Department of Agriculture of the Wisconsin State University writes: "Where the milk supply increases, it naturally follows that the butter fat will be increased. The reason for this is that the per cent of fat in milk does not change to any extent with the increase in milk production, or as a result of feeding or watering cattle."

Feed today is higher priced than it ever has been, and the wise dairyman must get the highest yield possible from each cow at the minimum cost of feed.

It, therefore, follows that a plentiful and pure supply of water is one of the most important things to be considered in the conducting of a money-making dairy farm.

Henry and Morrisson in their excellent book: "Feeds and Feeding" lay particular stress on the necessity of sufficient water for cattle. We will quote at random from their book: "Animals can live much longer without solid food than without water and an insufficiency of water in the body causes serious disturbances.—The process of mastication is hindered, the intestines are not properly flushed and the waste matter remains too long therein; the blood thickens and the body temperature is increased. — Through these complications death may result.—Animals deprived of water for a long period lose their appetite for solid food, vomiting and diarrhea may occur, the latter also often taking place when water is again supplied. Under normal conditions, animals consume a fairly uniform quantity of water for each pound of dry matter eaten; this is estimated at 4 to 6 pounds of water for milch cows, 4 to 6 pounds for oxen, 2 to 3 pounds for horses and sheep, and for swine 7 to 8 pounds. Water is an important regulator of the temperature of the animal body. A large amount of heat is absorbed in converting water into the vapor given off by the lungs and skin, and when sweat evaporates it

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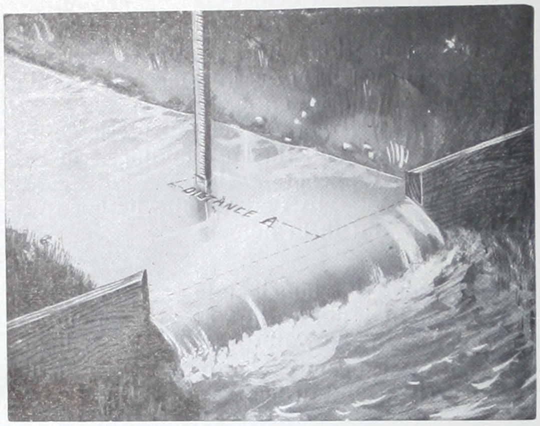
How to measure the flow of Water

The most common method of measuring the flow of water from a pump or stream is by constructing a weir. The weir consists of a rectangular notch cut in a dam across the stream or in the side of a box into which the pump discharges. The notch should be centered and its width should not be more than three-fourths the width of the box. It should be sufficiently wide, however, so that the water flowing over the lip will not be over 10 inches or less than 1 inch deep. The depth of water flowing over the weir must not be more than one-half the drop outside. The edges of the notch should be beveled on the side and top. The box should be long enough so that the water will be quiet before it reaches the weir and wide enough so that the flow will not be too rapid.



Four feet back from the lip of the weir, as shown by the distance "A", a post is set with its top exactly level with the lip. An ordinary rule set on this post serves to measure the depth of the water flowing over the lip.

Gallons per Minute Flowing for Each Inch Length of Weir, with the Given Depths at the Lip

Inches Depth	Gallons Per Min.	Inches Depth	Gallons Per Min.	Inches Depth	Gallons Per Min.	Inches Depth	Gallons Per Min.	Inches Depth	Gallons Per Min.	Inches Depth	Gallons Per Min.
1	3.06	2⅝	12.96	4⅛	25.47	5⅝	40.50	7⅛	57.78	8⅝	76.95
1⅛	3.60	2¾	13.86	4¼	26.64	5¾	41.85	7¼	59.31	8¾	78.66
1¼	4.22	2⅞	14.85	4⅜	27.81	5⅞	43.29	7⅜	60.84	8⅞	80.28
1⅜	4.86	3	15.75	4½	28.98	6	44.64	7½	62.37	9	81.99
1½	5.58	3⅛	16.74	4⅝	30.24	6⅛	46.08	7⅝	63.99	9⅛	83.70
1⅝	6.30	3¼	17.82	4¾	31.41	6¼	47.43	7¾	65.52	9¼	85.41
1¾	7.02	3⅜	18.81	4⅞	32.67	6⅜	48.87	7⅞	67.14	9⅜	87.21
1⅞	7.83	3½	19.89	5	33.93	6½	50.31	8	68.76	9½	88.92
2	8.64	3⅝	20.97	5⅛	35.28	6⅝	51.75	8⅛	70.30	9⅝	90.72
2⅛	9.45	3¾	22.05	5¼	36.54	6¾	53.28	8¼	72.00	9¾	92.43
2¼	10.26	3⅞	23.13	5⅜	37.89	6⅞	54.72	8⅜	73.62	9⅞	94.23
2½	11.97	4	24.30	5½	39.15	7	56.25	8½	75.24	10	96.03

Frequently it is necessary to correct for rapid flow of water. This can be measured by timing sticks floating on the surface. The following table shows proper amounts to add to measured depths for different speeds.

Speed of timing sticks in feet per second	.5	1	1.5	2
Add to measured depth in inches	1-16	¼	⅝	1⅛

EXAMPLE

When the notch is 40 inches wide and the rule shows water to be 5 inches deep:

40 (width of) (notch in) (inches)	×	**33.93** (Gallons per) (minute per) (table)	=	**1357.2** (Gallons of) (water per) (minute available)

If timing sticks float at the rate of 1 foot per second add ¼ inch (as given in table above) to depth which equals 5¼ inches:

40 (width of) (notch in) (inches)	×	**36.54** (Gallons per) (minute per) (table)	=	**1461.6** (Gallons of) (water per) (minute) (available)

How much Water is Needed for Average Homes and Farms

The principal factors affecting water consumption are accessibility, pressure, quality and quantity of the supply, varying daily and seasonal needs, and personal differences of taste and habit. If carried by hand a long distance, water will be used sparingly, perhaps one or two buckets drawn before mealtime sufficing for a family. If delivered under pressure and of good quality and ample quantity, it will be used liberally. Large quantities are used on wash days, during very hot weather, and, if water is wasted at the faucets to prevent freezing, during very cold weather A bath requires 25 to 30 gallons, and each flush of a toilet takes from 3½ to 6 gallons. Fair requirements in rural homes are shown in the following table:

Water requirements in rural homes.

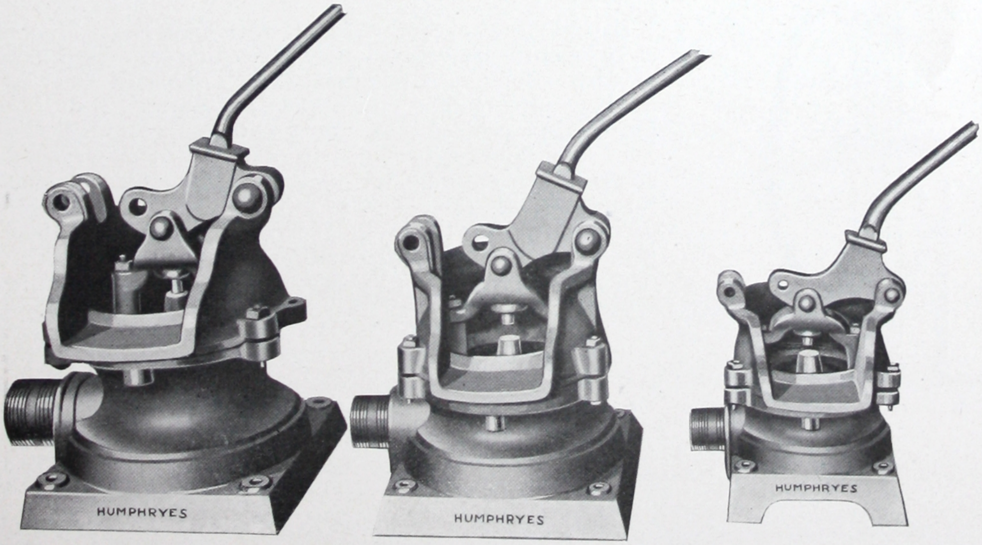
Purposes and conditions.	Consumption per person for 24 hours.
	Gallons
Domestic purposes, 1 pump at kitchen sink	8
Domestic purposes, 1 faucet at kitchen sink	15
Domestic purposes, running hot and cold water in kitchen, bathroom, and laundry	25
Sprinkling and cooling purposes, outdoor washing, waste, leakage, etc.	15
Average daily consumption, modern home	40
Maximum daily consumption, modern home	100
Average daytime consumption (7a.m. to 7 p.m.)	28

As to the requirements of stock, animals prefer a living spring or a stream of pure cool water, and will go a long distance to obtain it. If supplied from artificial sources, fair allowances are 12 gallons per day for each horse, mule or cow, and 2 gallons per day for each sheep or hog. Heavily worked horses and mules and milch cows may consume 20 to 25 gallons per day in hot weather, and with all farm animals conditions of weather, food, and living may double or halve the ordinary requirements.

Example

For a family of four with 2 horses and 5 cows
4 (number in family) × 40 Gallons (as per table) = 160 gallons
2 (number of horses) × 12 Gallons (as per table) = 24 gallons
5 (number of cows) × 12 Gallons (as per table) = 60 gallons
Total number of gallons used in 24 hours. = 244 gallons

For Pumping Gritty or Muddy Water in large quantities



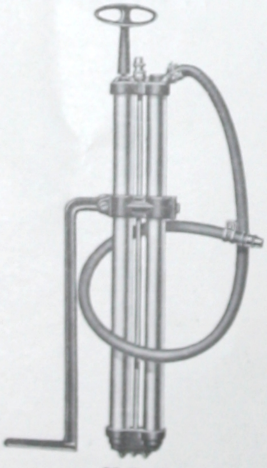
The H 769 Diaphragm Trench Pumps will handle from 1500 to 5000 gallons of gritty or sandy water per hour. Ask for Bulletin No. 265

What Size of Pump and Engine is required for Irrigation of Different Areas

Area	Water required per 2-inch irrigation	Capacity of pump per minute	Diameter of cylinder and length of stroke in inches		Size of Discharge pipe	Friction loss in discharge pipe per 100 ft.	Efficiency of pump	Horse Power of engine per foot of lift.
Acres	Gallons	Gallons	Cyl.	Stroke	In.	Feet	per cent	
¼	13,500	10	3	5	1½	1.1	70	.02
½	27,000	10	3	5	1½	1.1	70	.02
1	54,000	20	3	5	2	1.0	70	.03
2	108,000	35	5	5	2½	.9	70	.05
3	160,000	35	5	5	2½	.9	70	.05

To illustrate the use of above Table, assume that it is desired to irrigate 3 acres, that the highest point of the land is 40 feet above the water supply, and that the pipe line from the pump to the land is 1,200 feet long; then from the table see that a 5 by 5 Double Acting Pump will be needed to supply this. To determine the horse power needed to operate the pump, determine first the total head and lift, which will amount to 40 feet, plus the friction loss. If 2½ inch pipe is used, the friction loss in it will be equivalent to .9 foot of head and lift for each 100 feet of pipe. There being 1,200 feet of pipe, the friction loss will be 12x.9=10.8 feet; so that the total head and lift to be considered will be 40 + 10.8 = 50.8 feet. The total horse power called for will then be 50.8 × .05 = 2.5.

For Spraying and White Washing



H-567½

H-567½ Bucket Spray Pump with foot rest, adjustable as to height. Galvanized steel hose clamps are used instead of wire. Pump is strengthened by galvanized steel re-inforcing rod extending entire length of pump. Base is cast brass with machined brass valve seats and metal ball valves. Suction strainer is provided to prevent dirt or foreign substances from entering the pump. Each pump is regularly furnished with three feet of 3-8 inch spray hose and one each Fig. H 3000 fine and coarse spray nozzles. Packed in individual waterproofed carton.

H-567. Same as Fig. H-567½ with bucket clamp.

"When and What to Spray" See page 25 of this bulletin.

How Much Water does a Cistern or Tank Hold

Depth in Feet	Diameter of Cistern In Feet 4		5		6		7		8		9		10		11		12	
	Gal.	Bbl.	Gal.	Bbl.	Gal.	Bbl.	Gal.	Bbl.	Gal.	Bbl.	Gal.	Bbl.	Gal.	Bbl.	Gal.	Bbl.	Gal.	Bbl.
4	376	12	588	19	846	27	1,152	37	1,504	48	1,904	60	2,350	75	2,844	90	3,384	107
5	470	15	735	23	1,058	34	1,439	46	1,880	60	2,380	76	2,938	93	3,555	113	4,230	134
6	564	18	881	28	1,269	40	1,727	55	2,256	72	2,855	91	3,525	112	4,265	135	5,076	161
7	658	21	1,028	33	1,481	47	2,015	64	2,632	84	3,331	106	4,113	131	4,976	158	5,922	188
8	752	24	1,175	37	1,692	54	2,303	73	3,008	96	3,807	121	4,760	149	5,687	181	6,768	215
9	846	27	1,322	42	1,904	60	2,591	82	3,384	107	4,283	136	5,288	168	6,398	203	7,614	242
10	940	30	1,469	47	2,115	67	2,879	91	3,760	119	4,759	151	5,875	187	7,109	226	8,460	269
11	1,034	33	1,616	51	2,327	74	3,167	101	4,132	131	5,235	166	6,463	205	7,820	248	9,306	295
12	1,128	36	1,763	56	2,537	81	3,455	110	4,512	143	5,711	181	7,050	224	8,531	271	10,152	322

Example

To find capacity of a round cistern or tank 8 feet in diameter by 9 feet deep, the above table shows a capacity of 3384 gallons or 107 barrels.

What Size of Pipe to Use

Information heretofore given on pipe has been so vague that the following complete table of dimensions should prove of great value to any one considering the installation of a pump.

Light Wrought Iron Water Well Casing Inside Diameter	Outside Diameter	Nominal Wt. per Ft. Lbs.	Threads per inch	Outside Diameter of Coupling	Merchant Steel Pipe Nominal Inside Diameter	Actual Inside Diameter Inches	Actual Outside Diameter	Internal Area Inches	Nominal Wt. per Ft. Lbs.	Threads per inch	Diameter of Couplings	Length of Couplings	Contents in Gallons per foot
2 in.	2¼ in.	2.22	14	2¾ in.	⅛ in.	0.270	0.405 in.	0.0572	.24	27	⁴¹⁄₆₄ in.	¹⁵⁄₁₆ in.	.0006
2¼ in.	2½ in.	2.82	14	2³¹⁄₃₂ in.	¼ in.	0.364	0.54 in.	0.1041	.42	18	⁵³⁄₆₄ in.	1 in.	.0026
2½ in.	2¾ in.	3.13	14	3¼ in.	⅜ in.	0.494	0.675 in.	0.1916	.56	18	⁵⁷⁄₆₄ in.	1¼ in.	.0057
2¾ in.	3 in.	3.45	14	3¹⁵⁄₃₂ in.	½ in.	0.623	0.84 in.	0.3048	.84	14	1¹⁄₁₆ in.	1⁷⁄₁₆ in.	.0102
3 in.	3¼ in.	4.10	14	3¾ in.	¾ in.	0.824	1.05 in.	0.5333	1.12	14	1⅜ in.	1⅝ in.	.0230
3¼ in.	3½ in.	4.45	14	4 in.	1 in.	1.048	1.315 in.	0.8627	1.67	11½	1⁴³⁄₆₄ in.	1¹⁵⁄₁₆ in.	.0408
3½ in.	3¾ in.	4.78	14	4⁹⁄₃₂ in.	1¼ in.	1.380	1.66 in.	1.496	2.24	11½	2¹⁄₃₂ in.	2 in.	.0638
3¾ in.	4 in.	5.56	14	4¹⁷⁄₃₂ in.	1½ in.	1.611	1.9 in.	2.038	2.68	11½	2¹¹⁄₃₂ in.	2¼ in.	.0918
4 in.	4¼ in.	6.00	14	4²⁵⁄₃₂ in.	2 in.	2.067	2.375 in.	3.355	3.61	11½	2⅞ in.	2¾ in.	.1632
4¼ in.	4½ in.	6.36	14	5⁵⁄₃₂ in.	2½ in.	2.468	2.875 in.	4.783	5.74	8	3⁵⁄₃₂ in.	3⅛ in.	.2550
4½ in.	4¾ in.	6.73	14	5⅜ in.	3 in.	3.067	3.5 in.	7.388	7.54	8	4 in.	3³⁄₁₆ in.	.3673
4¾ in.	5 in.	7.80	14	5⅝ in.	3½ in.	3.518	4. in.	9.887	9.00	8	4¹⁷⁄₃₂ in.	3⅜ in.	.4998
5 in.	5¼ in.	8.20	14	5⅞ in.	4 in.	4.026	4.5 in.	12.730	10.66	8	5¹⁄₁₆ in.	3¼ in.	.6528
5³⁄₁₆ in.	5½ in.	8.62	14	6¹⁄₁₆ in.	4½ in.	4.508	5. in.	15.939	12.49	8	5¹¹⁄₁₆ in.	3⅝ in.	.8263
5⅝ in.	6 in.	10.46	14	6⁹⁄₁₆ in.	5 in.	5.045	5.563 in.	19.990	14.50	8	6¼ in.	3⅝ in.	1.020
6¼ in.	6⅝ in.	11.58	14	7¼ in.	6 in.	6.065	6.625 in.	28.889	18.76	8	7⁷⁄₁₆ in.	3½ in.	1.469
6⅝ in.	7 in.	12.34	14	7³⁹⁄₆₄ in.	7 in.	7.023	7.625 in.	38.737	23.27	8	8¹³⁄₃₂ in.	4 in.	1.999
7¼ in.	7⅝ in.	13.55	14	8⅜ in.	8 in.	7.982	8.625 in.	50.039	28.18	8	9⅜ in.	4 in.	2.611
7⅝ in.	8 in.	15.41	11½	8²³⁄₃₂ in.	9 in.	9.001	9.688 in.	63.633	33.70	8	10²⁹⁄₃₂ in.	6¹⁄₁₆ in.	3.300
8¼ in.	8⅝ in.	16.07	11½	9⅜ in.	10 in.	10.019	10.75 in.	78.838	40.00	8	11³¹⁄₃₂ in.	6¹⁄₁₆ in.	4.081
8⅝ in.	9 in.	17.60	11½	9¹³⁄₁₆ in.	11 in.	11.0	11.75 in.	95.03	45.00	8			4.93
9⅝ in.	10 in.	21.90	11½	11 in.	12 in.	12.0	12.75 in.	113.0	49.00	8			5.87

The dimensions of well casing will enable one to determine the largest cylinder that can be used therein, and the weight will permit a true estimate of freight charges, while the outside dimensions of couplings will determine the largest size casing that can be used.

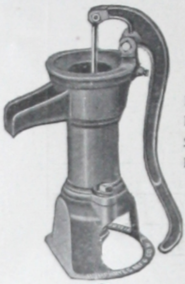
The same applies to pipe dimensions, and in addition the internal area in inches is given from which actual capacities of pipe can be computed. The actual contents in gallons per foot will be of immense value in determining the capacity of a given length of pipe.

Example

Stocks of pipe are often on hand, the trade sizes of which are not known. Suppose the inside diameter is 2 5-32″ or 2.468 inches and the outside diameter is 2 7-8″ or 2.875 inches; by referring to above table it will be seen that this is 2½ inch pipe. If this pipe is to be shipped to another point the freight charges would be 1200 (number of feet) X 5.74 (nominal weight per foot) which equals a total weight of 6, 888 lbs. X .147 per cwt. (assumed freight rate) equals $10.13.

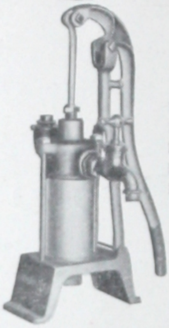
What Style of Pump to Use

With the countless styles of Pumps on the market, it is sometimes hard to decide which pump is adapted for your use. To this end we have compiled the following summary, with illustrations of the various types of Pumps to meet different needs:



H 350 Pitcher Spout Pump

When water is to be delivered at the spout only and the pump is to be installed inside the house for the lifting of water from a cistern or shallow well, when the lowest level of water in the cistern or well is not over 20 feet below the base of the pump, the Pitcher Spout Lift Pump is recommended. Ask for Bulletin No. 255 showing both open and closed spout pumps, sizes, capacities, and complete information.



H 367 House Lift and Force Pump

When the water is to be forced to the second story, tank in attic or some higher point than the level of pump, in addition to supplying water at the spout, the House Lift and Force Pump type is most satisfactory. Ask for Bulletin No. 257 showing pump in two sizes.

H 198 Set Length Lift Pump

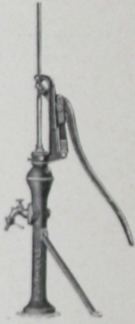
For outside use in open or driven wells not over 20 feet deep for supplying water at the spout only, the Hand Set Length Lift Pump is used. This can be furnished with solid cast stock or body, or pipe stock. The pipe stock pump is used mostly for driven wells. Ask for Bulletin No. 252 showing both styles. The same (cast stock) pump can be used in wells 50 feet or less in depth when the cylinder is placed within 15 feet of the water, in which case the pump and cylinder only are furnished, and the dealer will furnish enough 1-¼ inch pipe for this purpose. Bulletin No. 264 will give complete data on this pump.

H 432 Set Length Force Pump

For outside use, in wells not over 20 feet deep, if water is to be forced to some higher point, for example to an elevated tank or tank in loft of barn, in addition to supplying water at the spout, a Set Length Force Pump is the proper pump to use. The same pump can be used in deeper wells when the cylinder is placed within 15 feet of the water, in which case the pump and cylinder only are furnished and the dealer will supply enough 1¼ inch pipe for this purpose. When used with 2 inch diameter cylinder, these pumps should not be used in wells deeper than 130 feet; with 2½ inch diameter cylinder, 85 feet is the maximum depth of well; with 3 inch diameter cylinder, the pumps should not be used in wells of greater depth than 60 feet. Bulletin No. 266 shows all styles, sizes, etc.

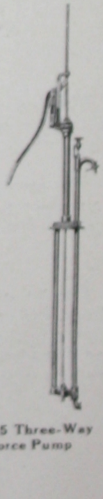
H 800 Windmill Lift Pump

For windmill as well as hand use, for lifting water only, a Windmill Lift Pump should be used. Sufficient pipe is used to bring cylinder within 15 feet of the water and sufficient pipe extending from the bottom of cylinder to the lowest level of the water. When used with 2 inch diameter cylinder, these pumps should not be used in wells deeper than 130 feet; with 2½ inch diameter cylinder, 85 feet is the maximum depth of well; with 3 inch diameter cylinder, the pumps should not be used in wells of greater depth than 60 feet. Bulletin No. 263 will give complete descriptions, illustrations, etc.



H 845 Windmill Force Pump

For windmill as well as hand use, when water is to be forced to an elevated tank or to some higher point, as well as delivering water at the spout, a Windmill Force Pump is recommended. The maximum depths of the well for which this pump is adapted are 2 inch diameter cylinder, 130 foot well; 2½ inch diameter cylinder, 85 foot well; 3 inch diameter cylinder, 60 foot well. Bulletins No. 260 and 262 give complete information regarding this type of pump.



H 875 Three-Way Force Pump

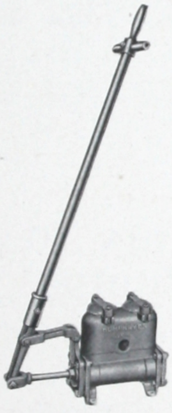
When water is to be piped underground to another point, as well as delivering water at the spout, for windmill as well as hand use, the Windmill Three Way Force Pump should be installed. This pump is anti-freezing and can also be furnished with a separate air cylinder for supplying air and water for a hydro-pneumatic system. Bulletins No. 253 and 261 describe this type of pump.

What Style of Pump to Use

The heart of the pump or the actual pumping unit is the cylinder. These can be furnished in various styles in polished iron, brass lined or brass tube, all of which are shown and described in Bulletin No. 271, which also gives capacities and maximum depth of well for each size. For deep well power installations, an artesian all brass well cylinder is used, fully described in Bulletin No. 276.

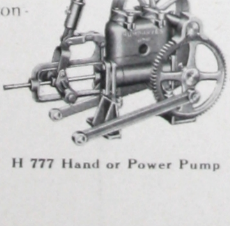
H 500 Cylinder

For forcing water not over 175 feet above the level of water in the well, for installation in house, cellar or outbuildings, for hand use and when the lowest level of water in the well is not over 20 feet, a Horizontal Double Acting Hand Force Pump is particularly adapted. When the lowest level of water in the well is not over 15 feet below the base of the pump, the water can be drawn safely a **horizontal** distance of not over 200 feet from the well to the pump. By equipping this pump with an automatic air intake valve, it is well adapted for hydro-pneumatic service. Please ask for Bulletin No. 251 for full information applying to this type of pump.



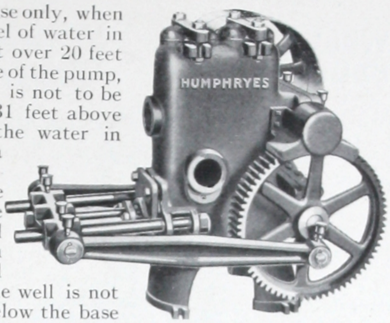
H 600 Hand Force Pump

For either hand or power use or for power use only (with handle for operation by hand in an emergency) when the lowest level of water in the well is not over 20 feet below the base of the pump, and the water is not to be forced over 175 feet above the level of the water in the well, a Hand or Power Horizontal Double Acting Force Pump should be used. When the lowest level of water in the well is not over 15 feet below the base of the pump, the water can be drawn safely a **horizontal** distance of not over 200 feet from the well to the pump. This pump can also be fitted with automatic air intake valve for hydro-pneumatic service. This same pump can be furnished mounted on cast iron sub-base, direct connected to motor or engine, or belt driven, with motor mounted on bracket instead of having the hand operation feature. Bulletin 277 will give full information pertaining to all of these units.



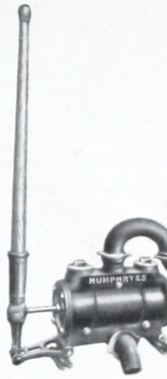
H 777 Hand or Power Pump

For power use only, when the lowest level of water in the well is not over 20 feet below the base of the pump, and the water is not to be forced over 231 feet above the level of the water in the well, a Power Horizontal Double Acting Force Pump should be used. When the lowest level of water in the well is not over 15 feet below the base of the pump, the water can be safely drawn a **horizontal** distance of not over 200 feet, from the well to the pump. Bulletin No. 272 fully describes this belt driven pump, as well as the same pump direct connected to motor or engine.



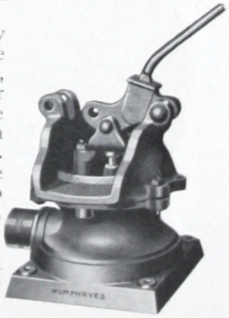
H 773 Power Pump

For use with outfits for threshing purposes or where a large capacity of water is wanted to be pumped by hand, the horizontal Double Acting Tank Pump is used. This pump has a 5 inch diameter cylinder, whereas the Horizontal Double Acting Hand Force pump has a 3 inch diameter cylinder. Tank pumps can be furnished complete with suction and discharge hose, bands, strainers, etc. fully described in Bulletin No. 268.



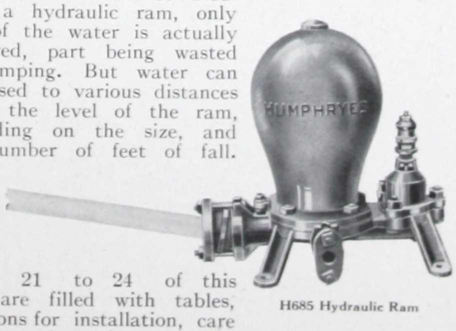
H 725 Tank Pump

For dirty, muddy or slimy water which would ruin the plunger of an ordinary pump, where the lowest level of water is not over 20 feet below the level of the pump, a Diaphragm Trench Pump should be used. Bulletin No. 265 will give complete information as to hose, strainers, diaphragms, etc.



H 769 Trench Pump

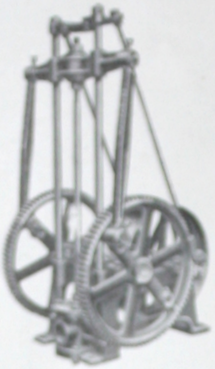
Where it is possible to obtain plenty of water from a spring or creek, and a vertical fall of not less than 5 feet from the spring to the ram, a Hydraulic Ram should be used. With a hydraulic ram, only part of the water is actually delivered, part being wasted in pumping. But water can be raised to various distances above the level of the ram, depending on the size, and the number of feet of fall.



H685 Hydraulic Ram

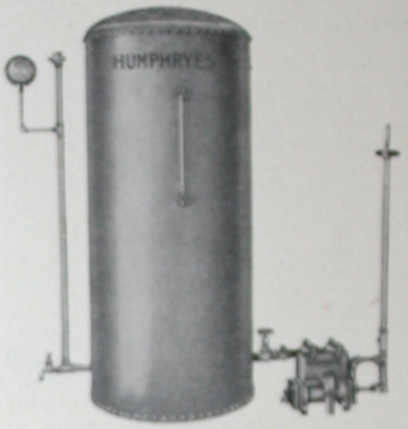
Pages 21 to 24 of this book are filled with tables, directions for installation, care and operation of these rams.

What Style of Pump to Use



H 940 Deep Well Head

When the water is to be pumped by power from a deep well, (over 20 feet below the level of pump) a Power Working Head should be used. Page 19 of this bulletin shows how these working heads are installed as to drop pipe, casing, deep well cylinder, etc. Bulletin No. 276 will supply illustrations of the various outfits, artesian all brass cylinders, necessary rod couplings, rod, etc



H 1000 Water Supply System

Where a constant supply of water is wanted at the turn of a faucet, a Domestic Water Supply or Pressure Tank System is highly recommended. Domestic Water Supply Systems are made in various styles, for hand operation, hand or power operation, electrically driven, automatic type or gasoline engine driven. Larger sizes are furnished for public institutions, factories, etc. and smaller systems for city or suburban residences. Bulletin No. 278 will be gladly mailed on application, and gives complete information. Page 19 of this bulletin gives detailed practical information.

What Kind of Motors to Use With Power Pumps

In selecting a motor to develop 2.55 horse power, the next highest standard size of motor or 3 horse power would be used. (1-8, 1-6, ½, ¾, 1, 1½, 2, 3, 5, 7½, and 10 horse power are standard sizes of motors). We can furnish standard motors at the same price as when purchased through other sources, but for your convenience, the following general information regarding standard motors is included:

Alternating current:

Single Phase Repulsion Induction Motors, Constant speed are recommended. When ordering in addition to horse power, it is necessary to give voltage (110 or 220), cycles (60, 40 or 25) and speed (1200 or 1800 r. p. m.) Two or Three Phase Enclosed Induction Motors, Constant Speed, squirrel cage type are recommended. When ordering, in addition to horse power it is necessary to give phase (2 or 3); cycles, (60 or 25); voltage, (110, 220, 440 or 550); and speed (1200 or 1800 r. p. m.)

Direct Current:

Constant Speed Compound Wound Direct Current Motors are recommended. When ordering, in addition to horse power it is necessary to give voltage (110, 220, or 550) and speed (1200 or 1800 r. p. m.)

When customer furnishes own motor, certified blue print should accompany each order with speed and horse power. When motors are to be direct connected by us on unit base with pump they should be purchased less base rail and pulley.

For motors for Deep Well service, special data is given on page 20 and should be referred to before ordering.

How to Estimate Power Required to Operate a Suction Lift Pump

This can best be explained by working out the following example:

What size motor is required to raise 30 gallons of water per minute to a vertical distance of 200 feet from source to highest point in delivery pipe, thru 980 feet of 2 inch pipe including 3 elbows?

First it is necessary to find the loss of head in feet due to the friction of the water flowing thru the 980 feet of 2″ pipe. Referring to the table below headed, Friction of Water in Pipes, we find opposite 30 gallons and under 2″ the value 2.73 feet, which is the loss of head in 100 feet of 2″ pipe for this number of gallons per minute. To find the loss for 980 feet we multiply 980 by 2.73 and divide by 100, which gives us 26.7 feet.

Friction of Water in Pipes

Loss of head in feet due to friction, per 100 feet of smooth, straight cast iron pipe

Gal's Per Min.	½ Inch Pipe		¾ Inch Pipe		1 Inch Pipe		1¼ In. Pipe		1½ Inch Pipe		2 Inch Pipe		2½ Inch Pipe		3 Inch Pipe		4 Inch Pipe	
	Vel.	Fric	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.
1	1.05	1.50																
2	2.10	5.30	1.20	1.40														
3	3.16	11.30	1.80	2.90	1.12	0.90												
4	4.21	19.20	2.41	5.00	1.49	1.52	0.86	0.40	0.63	0.187								
5	5.26	29.00	3.01	7.50	1.86	2.32	1.07	0.60	0.79	0.283	.51	.09	0.33	0.05				
10	10.52	105.00	6.02	27.10	3.72	8.40	2.14	2.18	1.57	1.02	1.02	0.36	0.65	0.12	0.45	0.05		
15			9.02	57.00	6.13	18.90	3.92	4.65	2.72	2.25	1.53	0.81	0.98	0.25	0.68	0.11		
20			12.03	97.00	7.44	30.10	4.29	7.90	3.15	3.70	2.04	1.29	1.31	0.43	0.91	0.18		
25					9.30	45.50	5.36	11.90	4.56	5.60	2.55	1.96	1.63	0.66	1.13	0.27		
30					11.15	64.00	6.43	16.90	4.72	7.80	3.06	2.73	1.96	0.92	1.36	0.38		
35					13.02	85.00	7.51	22.30	5.51	10.30	3.57	3.66	2.29	1.23	1.59	0.51		
40					14.88	109.00	8.58	28.50	6.30	13.30	4.08	4.68	2.62	1.57	1.82	0.65	1.02	0.16
45							9.68	35.20	7.08	16.60	4.60	5.80	2.95	1.97	2.02	0.80	1.17	0.20
50							10.72	43.20	7.87	20.20	5.11	7.10	3.30	2.38	2.27	0.98	1.28	0.24
70							15.01	81.00	11.02	37.60	7.15	13.20	4.60	4.42	3.18	1.83	1.79	0.45
75									11.80	42.70	7.66	14.90	4.93	5.07	3.41	2.11	1.92	0.52
100									15.74	73.00	10.21	25.60	6.54	8.60	4.54	3.52	2.55	0.88
120											12.25	36.00	7.84	12.00	5.45	4.97	3.06	1.22
125											12.75	38.90	8.16	13.01	5.68	5.40	3.19	1.33
150											15.30	54.00	9.80	18.72	6.80	7.72	3.84	1.82
175													11.43	23.70	7.92	9.75	4.45	2.40
200													13.07	30.90	9.08	12.80	5.11	3.12

Second it is necessary to find the loss of head due to the 30 gallons per minute flowing thru the 3 elbows. Referring to the table below headed, Friction of Water in Elbows, we find opposite 30 gallons and under 2″ the value 0.13 feet which is the loss of head for one elbow, and for three elbows it will be 3 times .13 or .39 feet.

Friction of Water in Elbows

Loss of head in feet, due to friction in various sizes of smooth 90° elbows when discharging the given quantities of water

Gal's Per Min.	1 inch		1¼ inches		1½ inches		2 inches		2½ inches		3 inches		4 inch	
	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.
5	2.04	0.06	1.30	0.02										
10	4.08	0.22	2.60	0.07										
15	6.12	0.49	3.90	0.16	2.73	0.09								
20	8.16	0.87	5.20	0.28	3.64	0.16								
25	10.20	1.35	6.50	0.45	4.55	0.25	2.60	0.09						
30	12.24	1.95	7.80	0.64	5.46	0.36	3.06	0.13						
35	14.28	2.65	9.10	0.88	6.37	0.50	3.57	0.18	2.29	0.09				
40	16.32	3.46	10.40	1.14	7.28	0.64	4.05	0.23	2.62	0.11				
45			11.70	1.45	8.19	0.81	4.60	0.29	2.95	0.14	2.02	0.06		
50					9.10	0.99	5.11	0.35	3.30	0.18	2.27	0.08		
70					12.74	1.98	7.15	0.70	4.60	0.34	3.18	0.14	1.79	0.05
100							10.20	1.41	6.54	0.74	4.54	0.29	2.55	0.10
120							12.25	2.24	7.84	1.17	5.45	0.05	3.06	0.15
150							15.30	3.20	9.80	1.58	6.80	0.66	3.84	0.22
175									11.43	2.16	7.92	0.90	4.45	0.30
200									13.07	2.96	9.08	1.18	5.11	0.40

When pipe is slightly rough add 15 %. When very rough add 30%.

Vel.—Velocity in feet per second.

Fric.—Friction head in feet.

Table shows loss for one elbow, and is based on Weisbach's Formula for short radius bends.

How to Estimate Power Required To operate a Suction Lift Pump

The loss of head due to the friction in pipe and elbows must now be added to the vertical distance above pump to which the water is to be pumped. In this case we have 200 plus 26.7 plus .39 equals 227.09 feet.

227.09, therefore, is the total head against which the pump must force the 30 gallons per minute. By referring to the table below we find opposite 30 gallons per minute and under 250 (the nearest number in this case) the value 1.87 horse power. This is the theoretical horse power required, and to find the size of electric motor or engine to operate this pump we divide this theoretical horse power by .70. In this case we have 1.87 divided by .70 equals 2.68 horse power. As the next highest rated electric motor is 3 horse power, this size should be selected. For the same reason a 3 horse power gasoline engine should be selected.

Table of Theoretical Horse-Power required to raise Water to different heights.

Feet	5	10	15	20	25	30	35	40	45	50	60	75	90	100	125	150	175	200	250	300	350	400
Gals. per min.																						
5	.006	.012	.019	.025	.031	.037	.044	.05	.06	.06	.07	.09	.11	.12	.16	.19	.22	.25	.31	.37	.44	.50
10	.012	.025	.037	.050	.062	.075	.087	.10	.11	.12	.15	.19	.22	.25	.31	.37	.44	.50	.62	.75	.87	1.00
15	.019	.037	.056	.075	.094	.112	.131	.15	.17	.19	.22	.28	.34	.37	.47	.56	.66	.75	.94	1.12	1.31	1.50
20	.025	.050	.075	.100	.125	.150	.175	.20	.22	.25	.30	.37	.45	.50	.62	.75	.87	1.00	1.25	1.50	1.75	2.00
25	.031	.062	.093	.125	.156	.187	.219	.25	.28	.31	.37	.47	.56	.62	.78	.94	1.09	1.25	1.56	1.87	2.19	2.50
30	.037	.075	.112	.150	.187	.225	.262	.30	.34	.37	.45	.56	.67	.75	.94	1.12	1.31	1.50	1.87	2.25	2.62	3.00
35	.043	.087	.131	.175	.219	.262	.306	.35	.39	.44	.52	.66	.79	.87	1.08	1.31	1.53	1.75	2.19	2.62	3.06	3.50
40	.050	.100	.150	.200	.250	.300	.350	.40	.45	.50	.60	.75	.90	1.00	1.25	1.50	1.75	2.00	2.50	3.00	3.50	4.00
45	.056	.112	.168	.225	.281	.337	.394	.45	.51	.56	.67	.84	1.01	1.12	1.41	1.69	1.97	2.25	2.81	3.37	3.94	4.50
50	.062	.125	.187	.250	.312	.375	.437	.50	.56	.62	.75	.94	1.12	1.25	1.56	1.87	2.19	2.50	3.12	3.75	4.37	5.00
60	.075	.150	.225	.300	.375	.450	.525	.60	.67	.75	.90	1.12	1.35	1.50	1.87	2.25	2.62	3.00	3.75	4.50	5.25	6.00
75	.093	.187	.281	.375	.469	.562	.656	.75	.84	.94	1.12	1.40	1.69	1.87	2.34	2.81	3.28	3.75	4.69	5.62	6.56	7.50
90	.112	.225	.337	.450	.562	.675	.787	.90	1.01	1.12	1.35	1.68	2.02	2.25	2.81	3.37	3.94	4.50	5.62	6.75	7.87	9.00
100	.125	.250	.375	.500	.625	.750	.875	1.00	1.12	1.25	1.50	1.87	2.25	2.50	3.12	3.75	4.37	5.00	6.25	7.50	8.75	10.00
125	.156	.312	.469	.625	.781	.937	1.094	1.25	1.41	1.56	1.87	2.34	2.81	3.12	3.91	4.69	5.47	6.25	7.81	9.37	10.94	12.50

Some Useful Tables

The following tables give feet head and the corresponding pressures per square inch, also the pressures per square inch and the corresponding values in feet head.

Table for Converting Feet Head of Water Into Pressure per Square Inch

Feet Head	Pounds per Square Inch	Feet Head	Pounds per Square Inch	Feet Head	Pounds per Square Inch
1	.43	55	23.82	190	82.29
2	.87	60	25.99	200	86.62
3	1.30	65	28.15	225	97.45
4	1.73	70	30.32	250	108.27
5	2.17	75	32.48		
6	2.60	80	34.65		
7	3.03	85	36.81		
8	3.40	90	38.98		
9	3.90	95	41.14		
10	4.33	100	43.31		
15	6.50	110	47.64		
20	8.66	120	51.97		
25	10.83	130	56.30		
30	12.99	140	60.63		
35	15.16	150	64.96		
40	17.32	160	69.29		
45	19.49	170	73.63		
50	21.65	180	77.96		

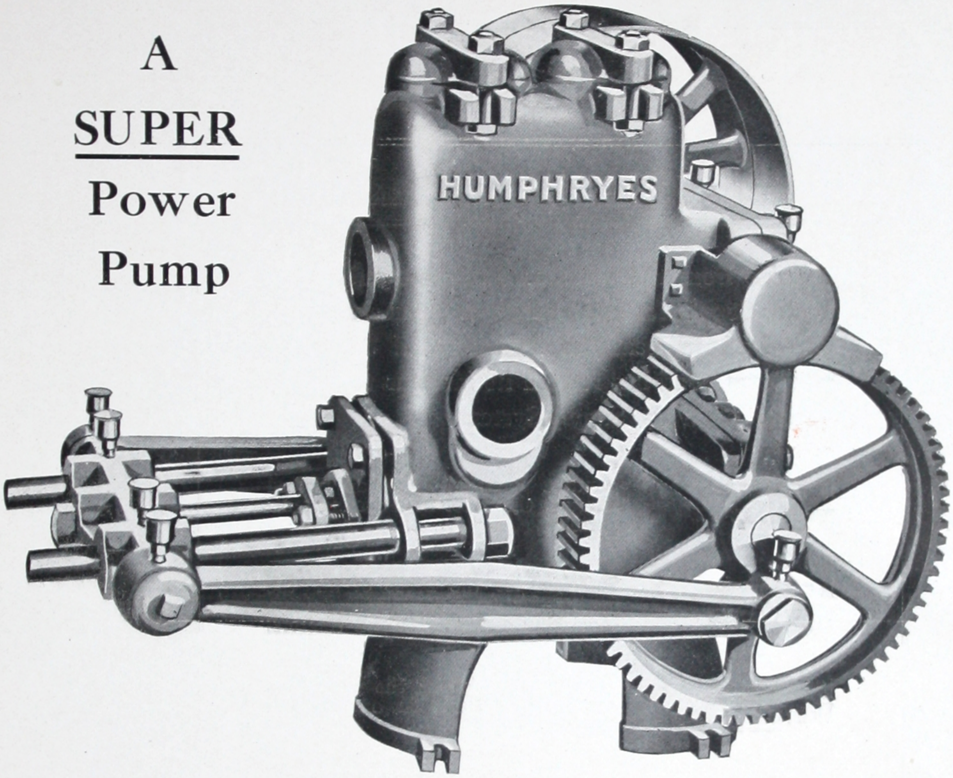
Table for Converting Pressure per Square Inch Into Feet Head of Water

Pounds per Square Inch	Feet Head	Pounds per Square Inch	Feet Head
1	2.31	55	126.99
2	4.62	60	138.54
3	6.93	65	150.08
4	9.24	70	161.63
5	11.54	75	173.17
6	13.85	80	184.72
7	16.16	85	196.26
8	18.47	90	207.81
9	20.78	95	219.35
10	23.09	100	230.90
15	34.63	110	253.98
20	46.18		
25	57.75		
30	69.27		
35	80.81		
40	92.36		
45	103.90		
50	115.45		

In the example explained above where we have a total head of 227.09 feet, to find the pressure per square inch or the pressure which would show on an ordinary pressure gauge, we find by looking opposite 250 and under Pounds per Square Inch the value 108.27. Therefore, a pressure gauge should show very nearly 108 pounds.

To find the total head in feet against which a pump is working: Suppose the gauge shows a pressure of 100 pounds; by looking opposite 100 pounds and under Feet Head we find 230.9 feet total head.

A SUPER Power Pump

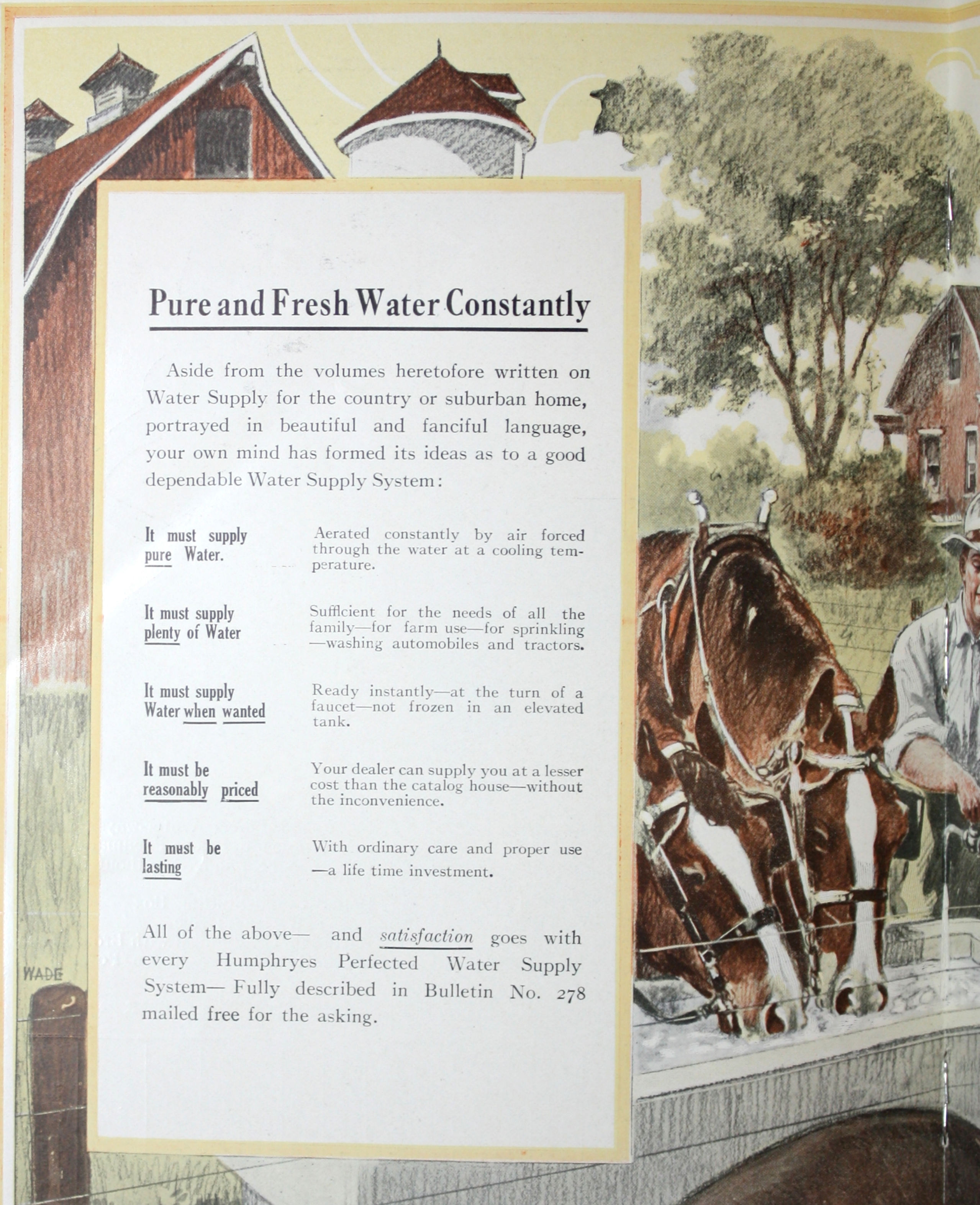


H-773
PATENT APPLIED FOR

1. One Piece Construction
2. Easy-to-Get-at Valves
3. Machine Cut Gear and Pinion
4. Wide Range of Capacities
5. Heavily Babbitted Bearings
6. Straight Line Thrust Alignment
7. Rubber Disc Valves on Bronze Grid Seats
8. Large and Direct Water-ways
9. Convertible into Hydro-Pneumatic Pump
10. Head can be removed without disturbing guide rods
11. Bolted Gland Stuffing Box
12. Disc and Gear Drive
13. Battleship Gray Finish with Bronze Trim
14. **More Gallons per Horse Power.**

14 POINTS SPELLING SUPER SATISFACTION TO THE USER

No.	Plunger Diameter, Inches	Plunger Stroke, Inches	Revolutions per Minute	Capacities in Gallons Per Revolution Per Minute	Capacities in Gallons Per Minute	Horse Power at Catalog Rating	Gear Ratio	Maximum Suction Lift, Feet	Maximum Discharge Elevation, including Friction, Feet	Maximum Safe Working Pressure, Pounds	Pipe Sizes Suction, Inches	Pipe Sizes Discharge, Inches	Pulleys, Diameter T. & L., Inches	Pulleys, Width Belt, Inches	Floor Space, Inches	Shipping Weight Pounds
3	3	5	Average 40	.31	12.	1½	5 to 1	20	231	100	2	1½	14	2½	33 x20	190
			Maximum 70	.31	21.7	2										
5	5	5	Average 40	.85	34.0	5	5 to 1	20	231	100	2½	2½	16	4	34½x29	475
			Maximum 50	.85	42.5	5										

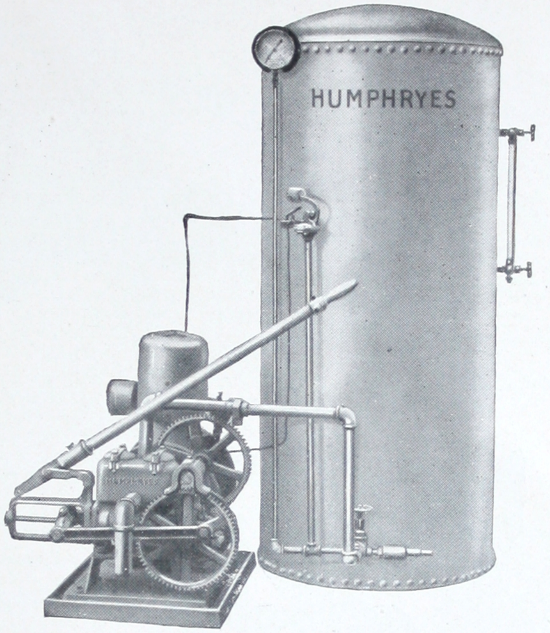


Pure and Fresh Water Constantly

Aside from the volumes heretofore written on Water Supply for the country or suburban home, portrayed in beautiful and fanciful language, your own mind has formed its ideas as to a good dependable Water Supply System:

It must supply pure Water.	Aerated constantly by air forced through the water at a cooling temperature.
It must supply plenty of Water	Sufficient for the needs of all the family—for farm use—for sprinkling —washing automobiles and tractors.
It must supply Water when wanted	Ready instantly—at the turn of a faucet—not frozen in an elevated tank.
It must be reasonably priced	Your dealer can supply you at a lesser cost than the catalog house—without the inconvenience.
It must be lasting	With ordinary care and proper use —a life time investment.

All of the above— and *satisfaction* goes with every Humphryes Perfected Water Supply System— Fully described in Bulletin No. 278 mailed free for the asking.

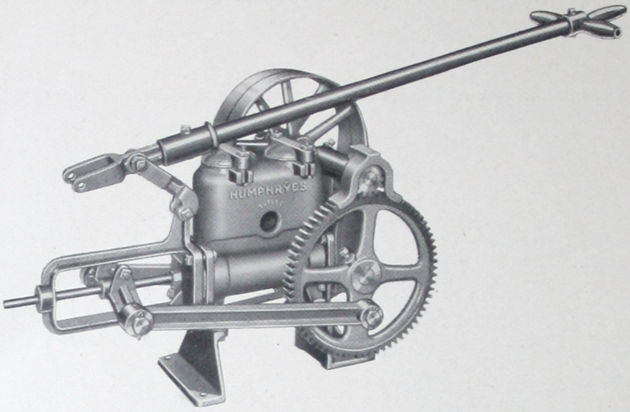


H 1025

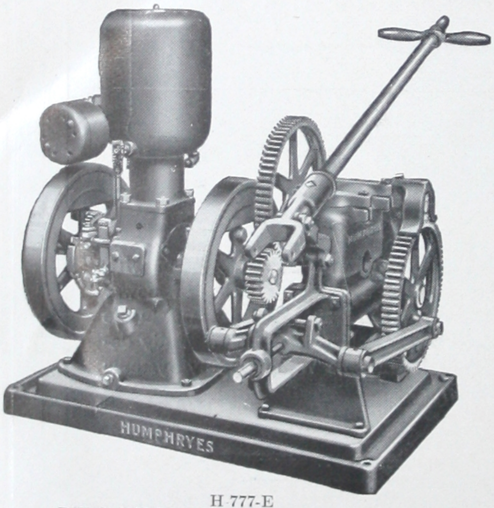
An ideal engine driven water Supply System with hand operating feature available in case of power failure. For use where the lowest level of water in the well is not over 20 feet below the pump. Fully described with other dependable Water Supply Systems in Bulletin No. 278.

Hand or Power Pneumatic Pumps

A remarkably sturdy power pump with handle attachment.

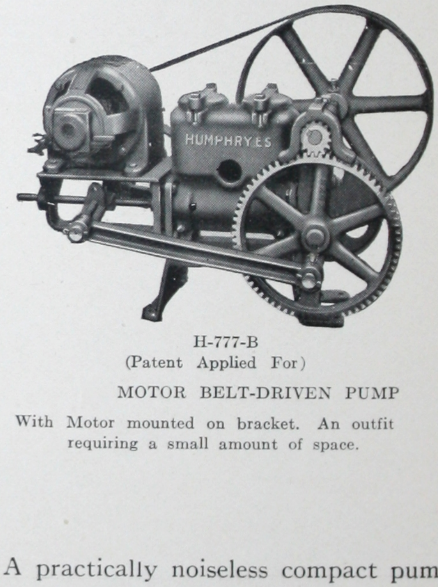


H-777
(Patent Applied For)
AS A POWER PUMP
Remove bolt, dropping handle back and attach connecting arms.



H 777-E
PUMP DIRECT-CONNECTED TO ENGINE
Mounted on sub-base for bolting to floor. Hand-operating feature is available in case of power failure.

An entirely self contained gasoline engine driven pumping unit requiring no special platform or foundation.



H-777-B
(Patent Applied For)
MOTOR BELT-DRIVEN PUMP
With Motor mounted on bracket. An outfit requiring a small amount of space.

A practically noiseless compact pumping unit supplying 720 gallons per hour.

Fig.	No.	Horse Power of Motor or Engine	Plunger Diameter, Inches	Plunger Stroke, Inches	Revolutions per Minute	Gear Ratio	Capacities in Gallons Per Revolution	Capacities in Gallons Per Minute	Maximum Suction Lift, Feet	Maximum Discharge Elevation, including Friction, Feet	Maximum Safe Working Pressure, Pounds	Pipe Size Suction, Inches	Pipe Size Discharge, Inches	Pulleys, Diameter T. & L., Inches	Pulleys, Width Belt, Inches	Horse Power at Catalog Rating	Floor Space, Inches	Shipping Weight, Pounds
H-777	3	....	3	5	40	5 to 1	.31	12	20	175	75	1½	1¼	12	2	¾	33x19	145
H-777-B	3	½	3	5	40	5 to 1	.31	12	20	100	44	1½	1¼	16*	1½	....	36x16	260
H-777-B	6	1	3	5	40	5 to 1	.31	12	20	175	75	1½	1¼	16*	2	....	36x16	280
H-777-E	3	1½	3	5	40	5 to 1	.31	12	20	175	75	1½	1¼	....	......	....	34x34	560

*Tight pulley only

How to Install Pumps for Satisfactory Service

The pump should be placed as near to the source of supply as possible, and not more than 20 feet above the level of same.

As the speed or working pressure is increased, it is necessary to place the pump closer to the water, and where it operates against a very heavy head the water should flow into the pump, thus completely filling the cylinders at each stroke. Hot, thick or volatile liquids should always flow to the pump. Place the pump on a good solid foundation. Be sure the pump sets level and that the base or feet have a solid bearing on the foundation, so that when the anchor bolts are tightened it will not pull the pump out of alignment. A good solid plank floor such as is usually found in well built factories is usually sufficient for our pumps, as they are self-contained and are not dependent upon foundations to maintain proper alignment of working parts.

Never use a smaller size pipe than that listed in bulletins or catalogs. When pipes are very long it is well to use larger sizes to reduce friction loss. All pipes should be as free from bends and sharp turns as possible. When turns are unavoidable use either long turn fittings or bend the pipe, thus reducing friction and danger of water hammer. It is of the utmost importance that the suction pipe be absolutely tight and it should gradually descend from the pump. A drop of six inches for each one hundred feet of length is good practice. If any part of the suction pipe is higher than the inlet on pump there will be an air pocket formed which will give trouble in operation.

Provided the elevation is not more than twenty feet, and that care is taken to give the pipe an even fall, water can be drawn horizontally by suction almost any distance, the limit being determined by the power exerted, and the quantity and velocity of the water passing through the pipe. A foot valve is recommended where the suction lift is over 15 feet, also where the suction line is over one hundred feet in length. Where there is danger of foreign substances being drawn through the suction pipes and into pump, a strainer should be provided at the end of suction pipe at source of supply. This strainer should have an area of at least four times the area of the suction pipe. The strainer should be one that can be examined and cleaned easily.

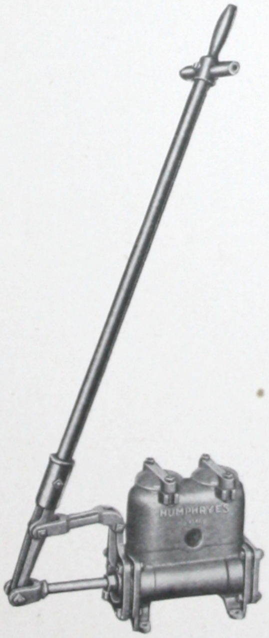
If a Gate Valve (never use a globe valve for this purpose) be placed in discharge pipe line near the pump, it will be found very convenient when it is necessary to examine the pump. In case a gate valve is used, a water relief valve should be placed between it and the pump to avoid damage should the pump be started with gate valve closed.

Keep the stuffing boxes evenly packed, but do not screw them down too tightly.

Give the pump reasonable attention.

Horizontal Double Acting Force Pump

The air chamber and cylinder are cast in one piece. The water ways are short, direct and of large area. The suction valves are lower than the suction pipe opening and prevent pump from losing its priming. The valves are rubber faced, resting on cast brass seats, and are easily accessible for examination or repairs. Steel pipe lever with cast iron handle. Brass cased steel plunger rod. Head is reversible, permitting suction or discharge to be taken from either side.



H 600

By removing the plug in back head and attaching our Fig. H-607 Air Valve, the pump can be converted into a hydro-pneumatic type for use with a domestic water supply system. A small extra charge is made for this air valve.

H 607 Air Intake Valve

3 inch diameter cylinder. 5 inch stroke. 1½ inch Suction. 1¼ inch Discharge.
Shipping Weight 65 pounds.

How to Prevent Trouble and How to Find Cause of Trouble

Operation

All pumps are thoroughly tested before leaving the factory and shipped in perfect condition. They should work satisfactorily at once, and if they do not, remember that the pump has operated satisfactorily before shipment under the conditions for which it was sold, and will do so again if properly assembled and installed.

Glands

Do not screw the glands down too tight, especially when starting a pump for the first time, as the packing swells and will produce unnecessary friction and wear, increasing the amount of power necessary to operate the pump. Tighten the glands enough to prevent leakage only. Excessive tightening of the glands on new packing is also apt to split the cylinder.

Valves

The valves should be examined occasionally to see if they are seating properly. Foreign substances are apt to be drawn up through the suction pipe and become lodged between the valve and seat, causing leakage and a corresponding reduction in the capacity of the pump. When metal valves are used, they should be ground to the seats occasionally, to insure proper operation.

Lubrication

Keep all bearings well lubricated. The metal gearing should also be oiled to prevent possible cutting, except when rawhide pinions are furnished.

Rawhide or Micarta Pinions

Use no oil on rawhide pinions; use Flaked Graphite only. The Rawhide Pinions should be protected from possible contact with moisture, or they will be destroyed.

Micarta Pinions are not affected by oil, moisture, acid fumes or atmospheric changes, are vermin proof and can be operated in oil without injury or lessened life. We would recommend using Micarta pinions instead of Rawhide.

Freezing

If a pump is located where there is danger of freezing when idle, it should be entirely drained. Drain plugs are provided for this purpose in all our pumps.

Hand Operated Pumps

If the pump loses its priming and the water runs down, the trouble is always below the plunger. Either the check valve in the bottom of cylinder is worn out, or something has lodged under it, preventing its closing down on the seat perfectly, or the bottom of the cylinder is not screwed on tight. Either of these causes, although not the fault of the pump, will prevent its working perfectly. If on examination you find a piece of gravel or dirt has lodged under the check valve, the suction pipe is probably set too close to the bottom of the well. The valve should wear for years, but if after long service it becomes worn out, it should be replaced with new, solid leather.

If the pump works hard, and the handle on being pushed down is inclined to jerk back, the suction pipe or strainer is stopped up and will not allow the water to enter the cylinder freely. In such cases it will usually be found that the lower end of the suction pipe or strainer is embedded in the sand or mud at sand or mud at the bottom of the well, or that something floating in the water has stopped up the entrance to the pipe.

If the pump does not throw a full stream, and the water comes out of the spout foamy, some of the joints are loose.

If a double-acting pump throws water on the up-stroke of the hand, but not on the down-stroke, the trouble is with the valve in the lower plunger. If it throws water on the down stroke, but not on the up stroke, the trouble is with the check valve.

For Hydro-Pneumatic Service

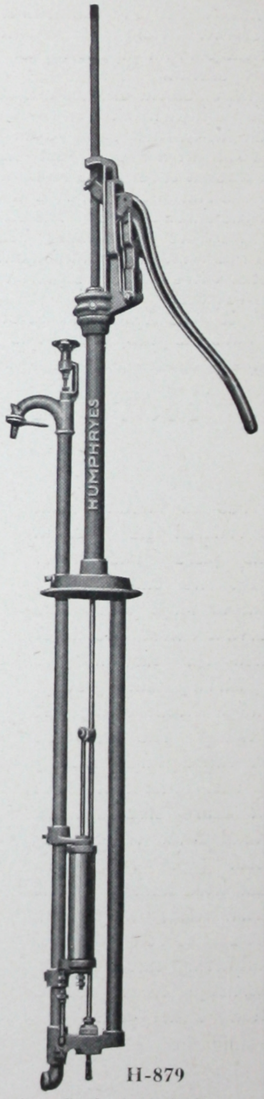
H879 Anti-Freezing Underground Three Way Windmill Force Pump with Hydro-pneumatic Air Cylinder The 2½ x 14 inch seamless brass tube air cylinder is operated in connection with the plunger rod of the pump, forcing a steady and ample amount of air into the discharge line of the pump with each stroke, and through the discharge pipe to the pressure tank.

Should there be too much air in the tank, close the hand wheel on the bottom of the water gauge and open the air cock, permitting the excess air to escape. By forcing the air with the water through the discharge pipe, the water is constantly aerated. A complete stroke of the pump is necessary, as a partial or jerky stroke will not deliver the required amount of air.

The opening and closing of the three way valve in the working head is operated by the hand wheel on the spout. The spout is fitted with Fig. H 992 Hose Clevis. The flat rod passes through a revolving bushing in the bearer, permitting the rod to be operated from any direction.

The stock is made from 2 inch iron pipe.

The ⅝ inch set length rod is coupled to the ⅝inch brass covered plunger rod which operates through the brass stuffing box. The air chamber is 1½ inch iron pipe, insuring a uniform flow of water. This pump is adapted for either shallow or deep well use.



H-879

Adjustable (6, 8. or 10) inch Stroke 2½ inch diameter Air Cylinder 10 inch Stroke Shipping Weight 125 lbs.

What a Hydro-Pneumatic System is

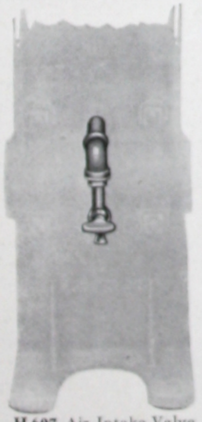
Hydro-pneumatic means Water and Air. Consequently, a hydro-pneumatic pump is one supplying both water and air, and a hydro-pneumatic tank is a tank containing both water and air. A system employing both such a pump and tank is a hydro-pneumatic water supply system. The advantages of a hydro-pneumatic system are that the tank can be conveniently placed in the cellar, basement, or buried in the ground (on account of rusting and inconvenience in inspecting and painting, underground tanks are not recommended.) and that water can be made available at as many points around the farm or home as desired, ready at the turn of a faucet.

Hydro-pneumatic tanks must be absolutely air-tight, for they operate on the simple principle of the expansion of the air forcing the water out of the tank into the pipes where needed. As air is considerably lighter than water, it occupies the top or upper portion of the tank. For house service, the pressure generally averages between 20 and 50 pounds per square inch. When air and water are under pressure, the water very gradually absorbs the air. The air supply must, therefore, be replenished, or the tank will be entirely full of water, or what is termed "Water-logged". The maintenance of the air supply in the tank is a very important part of the successful operation of a hydro-pneumatic system.

In order to deliver all of the water from a hydro-pneumatic tank, it is necessary to have an initial or excess air pressure to start; sufficient air to give air pressure when no water is in the tank. If a tank is placed in the cellar, 10 pounds is enough to deliver all the water to the second story, but if far removed or far below the house, a greater amount of air may be necessary. 20 pounds pressure in the tank will force water to a point 45 feet high, and 60 pounds pressure will raise it 135 feet high. The following table shows what fractional part of any tank, vertical or horizontal, contains water under different conditions of gage pressure and excess air pressure.

Gage pressure.	Excess air in tank in pounds.					Gage pressure.	Excess air in tank in pounds.				
	0	10	15	20	25		0	10	15	20	25
Pounds.						*Pounds.*					
100	0.870	0.783	0.739	0.696	0.652	50	0.769	0.615	0.538	0.462	0.385
95	.864	.773	.727	.682	.636	45	.750	.583	.500	.417	.333
90	.857	.762	.714	.667	.619	40	.727	.545	.455	.364	.273
85	.850	.750	.700	.650	.600	35	.700	.500	.400	.300	.200
80	.842	.737	.684	.632	.579	30	.667	.444	.333	.222	.111
75	.833	.722	.667	.611	.556	25	.625	.375	.250	.125	
70	.824	.706	.647	.588	.529	20	.571	.286	.143		
65	.812	.687	.625	.562	.500	15	.500	.167			
60	.800	.667	.600	.533	.467	10	.400				
55	.786	.643	.571	.500	.429	5	.250				

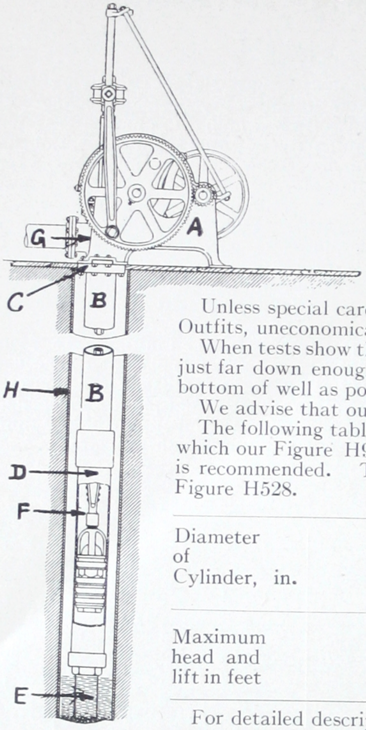
EXAMPLE: If water is pumped into any tank having no pressure above O until the gage shows 5 pounds, the tank will be one fourth filled with water; at 15 pounds it will be one-half full; at 30 pounds, will be two-thirds full; at 45 pounds it will be three-fourths full; at 60 pounds it will be four-fifths full. Inspection of the table also shows the value of excess air in a tank. If 25 per cent of the total capacity be drawn from a tank three-fourths filled with water and having a gage pressure of 45 pounds, the pressure will be reduced to 15 pounds. Had the tank contained 10 pounds excess air, 42 per cent of the total capacity (O.583 - O.167=O.416) could have been drawn between pressures 45 and 15 pounds. Under the latter condition, therefore, the working capacity of the tank would have been nearly doubled, the exact proportion being as 42 is to 25.


H 607 Air Intake Valve used on Pump Fig Nos. H 600, H 773 H 550 and H 777

Hydro-pneumatic tanks are made of steel plate, with either riveted or brazed joints. Tanks with riveted steel joints are recommended as being most satisfactory. They may be black or galvanized and be set vertically or horizontally, but it must be stated on the order whether a vertical or horizontal tank is wanted. Vertical tanks require less floor space, but when tanks are over 6 feet long, a horizontal tank is recommended.

The H 607 intake air valve will convert any horizontal double-acting force pump (H 600, H 777, H 773 or H 550) into a hydro-pneumatic pump. The head of each of these pumps is tapped for ¼ inch iron pipe, into which a standard brass pipe plug is regularly fitted. To convert to hydro-pneumatic use, merely unscrew the pipe plug and attach the air intake valve. By merely turning the thumb screw handle of this air valve, any desired amount of air can be taken into the water cylinder, be compressed and discharged into the pneumatic tank through the regular discharge pipe, at the same time aerating and cooling the water. Exhaustive tests show that this air intake valve will provide sufficient air for any of the pneumatic tank systems in common use. Tests included pumps of capacities up to 2,000 gallons per hour. Less work is required to compress air when the heat is taken up as fast as it is generated. In this case, the air enters the water cylinder direct and the air is compressed with the water.

Deep Well Pump Data



For the benefit of those not entirely familiar with the Deep Well Working Head style of pumping equipment, a cross-sectional view is given of a typical installation. As will be seen, the working head proper (A) is securely bolted to the platform or foundation. The drop or suction pipe (B) is fitted to the suction line of the working head by means of a bolted flange (C). The All Brass Artesian Well Cylinder, our Figure H528, (D) does the actual pumping, to the bottom of which the suction pipe (E) is fitted. The plunger rod of the artesian well cylinder is operated by the necessary lengths of octagon wood sucker or well rod, properly coupled with forged sucker rod couplings (F). The working head discharges through the discharge tee (G) and from that point is piped to the point desired. The casing of the well in the cross-sectional view is indicated by the letter "H".

Unless special care is taken in placing the cylinders in the well in Deep Well Pumping Outfits, uneconomical and poor results are sure to follow.

When tests show that the water level does not lower in the well, the cylinder may be placed just far down enough that it is always submerged. Otherwise it should be placed as near bottom of well as possible.

We advise that outfits be fitted so that cylinder is under water at all times.

The following table gives the maximum combined head and lift (including friction) for which our Figure H940 Power Working Head with adjustable 10, 12 and 14 inch stroke, is recommended. The diameter of cylinder refers to artesian well cylinders similar to our Figure H528.

Diameter of Cylinder, in.	1¾	2¼	2¾	3¼	3¾	4¼	4¾
Maximum head and lift in feet	790	437	292	210	158	122	98

For detailed description of our Figure H940 Working Head, send for Bulletin No. 276.

What kind of motor to use with Deep Well Working Head installations.

Direct current motors should be compound rather than shunt wound; alternating current motors should be of the slip ring type. Up to and including 10 horse power, the motor speed should not be greater than 1200 revolutions per minute, and from 10 horse power to 25 horse power, the motor speed should not exceed 900 revolutions per minute.

How to Estimate the Power Required to Operate a Deep Well Pump

This can best be explained by working out the following example:

What size motor is required to raise 10 gallons per minute from a well 100 feet deep to a point which is at a vertical distance of 100 feet above the well head? The water is to be conducted thru 500 feet of 1¼ inch pipe, and 3 ninety-degree elbows.

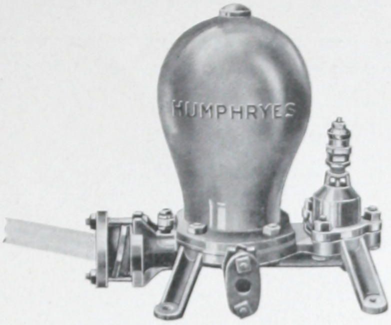
First it is necessary to find the loss of head in feet due to the friction of the water flowing thru the 500 feet of 1¼ inch pipe. Referring to the table of Friction of Water in Pipes on page nine opposite 10 gallons per minute and under 1¼" pipe we find the value 2.18 feet, which is the loss of head in 100 feet of 1¼" pipe for this number of gallons per minute. To find the loss for 500 feet we multiply 500 by 2.18 and divide by 100 which gives us 10.9 feet.

Second it is necessary to find the loss of head due to the 10 gallons per minute flowing thru the 3 elbows. Referring to the table of Friction of Water in Elbows on page nine opposite 10 gallons per minute and under 1¼" we find the friction to be .21 feet, which is the loss of head for one elbow, and for three elbows it will be 3 times .21 or .63 feet.

The loss of head due to the friction in pipe and elbows must now be added to the vertical distance above the level of the water in the well to which the water is to be pumped. As the well is 100 feet deep and the water is pumped 100 feet above the well and we have a loss of head due to pipe friction of 10.9 feet and loss due to elbow friction of .63 feet, we therefore will have 100 plus 100 plus 10.9 plus .63 equals 211.53 feet as the Total Head. This is the total head against which the pump must force the 10 gallons per minute.

By referring to the table of Theoretical Horse Power required to raise Water to different heights on page ten opposite 10 gallons per minute and under 200 feet (nearest value in this case) we find ½ horse power. This value must be multiplied by 3 to find the size of motor required. We therefore would use a 1½ horse power electric motor or gasoline engine to operate this pump.

How Water Can Pump Itself



H 685 (Patent Applied For)

The Hydraulic Ram is a very old form of pumping unit, being first manufactured in the seventeenth century. It is automatic in that it utilizes the fall of water to raise a part of that water to a point higher than its source.

To operate satisfactorily a ram should set level on its foundation, permitting the impetus valve to operate without side friction. To insure this our ram is fitted with a ball joint connection for drive pipe. The proper incline of drive pipe is therefore obtained without bending it. This is a feature found only on the Humphryes Hydraulic Ram.

Provision is made on the impetus valve to lengthen or shorten its stroke. As a rule the shorter the stroke with a given fall from source and delivery head, the higher will be the efficiency of the ram. In cases where the supply is abundant and where capacity is more desirable than efficiency, a long stroke should be used.

The ram is fitted with an automatic air intake valve which keeps the air chamber supplied with air and prevents it becoming water logged, insuring continuous operation of ram. A small spray of water from the valve at each stroke of impetus valve indicates that it is operating properly.

ALASKA · YUKON · PACIFIC · EXPOSITION
· 1909 · SEATTLE · 1909 ·

Medal awarded Humphryes Hydraulic Rams for Efficiency

TABLE OF SIZES

No.	Height In.	Length In.	Width In.	Pipe Sizes drive In.	Pipe Sizes delivery In.	Shipping weight lbs.
3	14	14	11	1	½	34
4	16	15	12	1¼	¾	48
5	20	17	12	2	1	70
6	23	19	14	2½	1¼	93

How to Install the Ram

The water is conducted to the ram by the Drive Pipe. This pipe should incline gradually to the ram and be free from sharp turns or elbows. The length of the drive pipe should be at least equal to two thirds the delivery head, or five times the drive head.

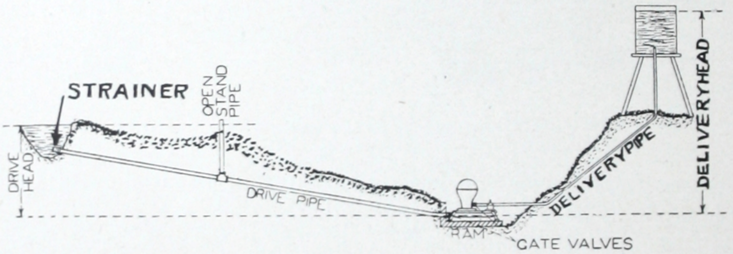
The inclination of the drive pipe should never be over 30 degrees at any place, and when the length or proper angle can not be had it is well to coil the drive pipe to a large radius so as to accomplish this. The drive pipe should be air tight.

The length of delivery pipe should not be over twenty times the lift or height to which water is to be forced above the ram.

The size of the drive pipe should always be the same as that for which the ram is fitted. The delivery pipe should never be less than the size for which the ram is fitted, but in case the ram is at considerable distance from the reservoir the loss due to friction in the pipe may be cut down by using a larger pipe, and therefore the amount of water delivered will be increased.

Gate valves should be placed on the drive and delivery pipes as close to the ram as possible. A strainer should be placed over the end of the drive pipe at the source to prevent leaves and other foreign substances from passing down to the ram. Unless the pipes are free from obstructions the ram will not work properly.

Where it is impossible to obtain sufficient fall within the required length of pipe, the water may be conveyed any distance and an open standpipe or barrel placed in the pipe line at the required distance from the ram, as shown in sketch below.



This standpipe should be at least one size larger than the drive pipe. In some places it may be more convenient to sink the ram in a pit to secure the desired fall and convey the waste water through a drain pipe to a point where it will flow away.

To operate satisfactorily, a ram should set level on its foundation, permitting the impetus valve to operate without side friction. **To insure this the Humphryes Hydraulic Ram is fitted with the Any-Angle Ball Joint connection for drive pipe. The proper incline of drive pipe is therefore obtained without bending it. This is a feature found only on the Humphryes Hydraulic Ram.** The Ram should always be securely fastened on timbers or on masonry foundation and not left dependent merely upon pipe connections.

Turns or Bends in either drive or discharge pipe should be as few as possible and when it is necessary to make a turn, bend the pipe in preference to using elbows. Where it is necessary to use elbows in the Discharge pipe, have them as large as possible to overcome friction.

A drain should be provided to carry off the waste water, and the ram should be suitably housed to prevent freezing in cold weather.

Care should be taken to see that all scale and sediment is removed from the Drive pipe before connecting to ram, as this sediment works loose and collects in the impetus valve, which decreases the efficiency and at times closes it entirely.

The above instructions and all necessary data are given on a green instruction card which accompanies every ram when shipped.

How to Spray Effectively, Whitewash, etc.

In the past we have issued quite an extensive list of formulas for making insecticides, etc. by combining various elements obtained at the local drug or hardware stores. By this method, there were, without doubt, some very good insecticides produced, but it is often impossible for the farmer or fruit grower to obtain the proper raw materials, and after he has obtained them, he has not the equipment to determine whether they are of the proper strength and suited to his use. On the other hand, various reputable manufacturers have established complete departments for the manufacture of these insecticides. All materials are carefully tested by experienced chemists, and the factories are equipped with high grade costly machinery for making up the raw materials.

We, therefore, do not believe that the farmer or fruit grower who values his labor, and the money he has invested in his equipment (and only uses it a few months in a year) would want to take chances on using a home made insecticide, but would want to spend a few cents more and be certain of the result. There are several reliable manufacturers of such insecticides, but we are including, through the courtesy of The Sherwin-Williams Company, Cleveland, Ohio, a Handy Spraying Schedule which should be helpful to the farmer or fruit-grower having a medium or medium large amount of spraying to do. Their products as given in the chart are on sale at almost any hardware store. Your hardware dealer can obtain for you a copy of their text book on spraying and dusting entitled "The Sprayers Manual" or this may be obtained by writing to them direct.

Dry Arsenate of Lead is the powdered form of the familiar paste form of arsenate of lead. It will not freeze, is one third arsenic and is cleaner and easier to handle than the paste form.

Lime-Sulphur solution is known to everyone who has handled spray insecticide materials. Dry Lime Sulfur is the powdered form and dissolves readily in cold water, adhering to the foliage for the longest possible time.

Bordeaux Mixture is a well known mixture containing a percentage of copper. Fungi-Bordo is the prepared powder form of the same mixture.

Paris Green is too well known to require explanation.

Dry Powdered Insecto is a specially prepared insecticide for grape pests and is very effective.

A Handy Spraying Schedule

Pest	What to Use	Dilution	First Spraying	Second Spraying
Codling Moth	Dry Arsenate of Lead	*1 to 1½ lbs.	Immediately after blossoms fall	10 days later
San Jose Scale	Dry Lime-Sulfur	*10 to 14 lbs.	After leaves fall	Before leaves appear
Canker Worm	Dry Arsenate or Lead	*1 to 1½ lbs.	When young first appear	4 to 6 days later
Tent Caterpillar	Dry Arsenate of Lead	*1 to 1½ lbs.	As insects appear	As needed
Leaf Crumpler	Dry Arsenate of Lead	*1 to 1½ lbs	About middle of May	As needed
Bitter Rot	Fungi-Bordo	*7 to 9 lbs.	About middle of May	
Apple Scab	Dry Lime-Sulfur	*10 to 14 lbs.	Just before buds open	When blossoms have dropped (2½ to 3 lbs. to 50 gals. water)
Peach Leaf Curl	Dry Lime-Sulfur	*10 to 14 lbs.	Late in March when trees are dormant	After buds open (2 lbs. to 100 gals. water or use self-boiled mixture)
Pear Slug	Dry Arsenate of Lead	*1 to 1½ lbs.	When insects appear	Repeat after 10 days or 2 weeks if necessary
Pear Psylla	Dry Lime-Sulfur	*10 to 14 lbs.	Late in Fall or early Spring	After foliage opens (2½ to 3 lbs. to 50 gals. water)
Plum Gouger	Dry Arsenate of Lead	*¾ to 1 lb.	Before leaves and buds open	
Grape Black Rot	Dry Lime-Sulfur	*10 to 14 lbs.	Before buds open	Use S-W Dry Powdered Insecto, 6 to 8 lbs. to 50 gals. of water, after blossoms fall
Grape Root Worm	Dry Powdered Insecto	*6 to 8 lbs.	As soon as beetle appears	Also use scalding water on roots
Grape Berry Moth	Dry Powdered Insecto	*6 to 8 lbs.	Just before bloom	At intervals of 10 days
Strawberry Crown Borer	Dry Arsenate of Lead	*1 to 1½ lbs.	Late in Summer	
Strawberry Leaf Roller	Dry Arsenate of Lead	*1 to 1½ lbs.	In August	After fruit has been gathered burn fields over
Strawberry Slug Strawberry Root Worm	Paris Green or Dry Arsenate of Lead	*4 to 6 ozs. *1 to 1½ lbs.	In May when insects appear	
Imported Currant Worm	Dry Arsenate of Lead	*1 to 1½ lbs.	As soon as insects appear	Repeat as often as needed
Gooseberry Fruit Worm	Dry Arsenate of Lead	*1 to 1½ lbs.	As soon as insects appear	Later as needed
Raspberry Slug	Paris Green or Dry Arsenate of Lead	*4 to 6 ozs. or *1 to 1½ lbs.	Early in Spring	
Raspberry Byturus	Dry Arsenate of Lead	*1 to 1½ lbs.	1st of May	

*To 50 gallons of water

Humphryes Spray Pumps are coming into wide use for whitewashing or cold water painting purposes. The H570 barrel spray pump, when mounted on barrel, or on barrel truck is particularly well adapted for this use. In connection with whitewashing, we would recommend the use of the H3040 Non Klog Whirlwind nozzle as described in our Spray Pump Bulletin No. 269, which may be had on application Your hardware or implement dealer will be able to supply you with cold water paint in powder form, requiring only the addition of water and thorough mixing before applying.

Useful Tables and Valuable Information

One cubic inch of water weighs .0361 pounds

One pound equals 27.7 cubic inches of water.

One cubic foot equals 62.4245 pounds at 39 degrees Fahr.; 7.48 gallons U. S.; 6.2321 gallons Imperial.

One gallon U. S. equals 8.33111 pounds; 231 cubic inches; .13368 cubic feet.

One imperial gallon equals 10 pounds at 62 degrees Fahr.; 277.274 cubic inches; .16046 cubic feet.

One pound pressure equals 2.31 feet in height.

One foot in height equals .433 pounds pressure.

Petroleum weighs 6½ pounds per U. S. gallon, 42 gallons to the barrel.

To convert imperial gallons into U. S. gallons, multiply by the factor 1.2. To convert U. S. gallons into imperial gallons, multiply by the factor .8333.

A miner's inch is a measure for flow of water, and is the quantity of water that will flow in one minute through an opening one inch square in a plank 2 inches thick under a head of 6½ inches to the centre of the orifice. This is equivalent, approximately, to 1.53 cubic feet, or 11½ gallons per minute. This varies in different states.

One acre-inch is the quantity of water required to cover one acre of area a depth of one inch, equals 3,630 cubic feet, equals 27,152 gallons.

One acre-foot equals 12 acre-inches, equals 43.560 cubic feet, equals 325,829 gallons.

One cubic foot per second (second-foot) equals 448.8 gallons per minute.

A flow of one second-foot will produce one acre-inch in about an hour.

The mean pressure of the atmosphere is usually estimated at 14.7 pounds per square inch, so that with a perfect vacuum it will sustain a column of mercury 29.9 inches, or a column of water 33.9 feet high at sea level.

The resistance of friction in the flow of water through pipes of uniform diameter is independent of the pressure and increases directly as the length and the square of the velocity of the flow, and inversely as the diameter of the pipe. With wooden pipes the friction is 1.75 times greater than in metallic pipes. Doubling the diameter increases the capacity four times.

To determine the velocity in feet per minute necessary to discharge a given volume of water in a given time, multiply the number of cubic feet of water by 144 and divide the product by the area of the pipe in inches.

To determine the area of a required pipe, the volume and velocity of water being given, multiply the number of cubic feet of water by 144 and divide the product by the velocity in feet per minute.

To determine the area in square inches of a required pipe, the number of gallons per minute and the velocity of the water in feet per second being given, multiply the number of gallons per minute by .321 and divide by the velocity in feet per second

To determine the velocity in feet per second necessary to discharge a given number of gallons per minute, thru a given area, multiply the gallons per minute by .321 and divide by the given area in square inches.

To find the theoretical velocity due to any head, multiply the square root of the head in feet by 8.02.

Comparisons of Liquid Measures and Weights

Measures and Weights for Comparison	Measure And Weight Equivalents of Items In First Column								
	U. S. Gallon	Imperial Gallon	Cubic Inch	Cubic Foot	Cubic Meter	Liter	Pound	*Vedro	*Pood
U. S. Gal.	1.	.833	231.	.1337	.00378	3.785	8.33	.308	.231
Imp. Gal.	1.20	1.	277.27	.1604	.00454	4.542	10.	.369	.277
Cu. In.	.0043	.00358	1.	.00057	.000016	.0163	.0358	.00132	.001
Cu. Ft.	7.48	6.235	1728.	1.	.02827	28.312	62.355	2.304	1.728
Cu. Met.	264.17	220.05	61023.	35.319	1.	1000.	2200.54	81.364	61.023
Liter	.26417	.2200	61.023	.0353	.001	1.	2.2005	.08136	.06102
* Vedro	3.249	2.706	750.1	.4344	.01228	12.29	27.06	1.	.7501
* Pood	4.328	3.607	1000.	.578	.01636	16.381	36.07	1.333	1.
Pound	.12	.1	27.72	.016	.00045	.454	1.	.0369	.0277

*Vedro and Pood are a Russian measure and weight respectively.

Mechanical, Electrical and Heat Comparisons

H. P.
- 746 watts.
- 0.746 K. W.
- 33,000 ft. lbs. per minute.
- 550 ft. lbs. per second.
- 2,545 heat-units per hour.
- 42.4 heat-units per minute.
- 0.707 heat unit per second
- 0.175 lb. carbon oxidized per hour.
- 2.64 lbs. water evaporated per hour from and at 212° F.

1 Kilowatt
- 1,000 watts
- 1.34 horse power.
- 2,654,200 ft.-lbs. per hour.
- 44,240 ft.-lbs. per minute.
- 737.3 ft.-lbs. per second.
- 3,412 heat-units per hour.
- 56.9 heat-units per minute.
- 0.948 heat-units per second.
- 0.2275 lb. carbon oxidized per hour.
- 3.53 lbs. water evaporated per hour from and at 212° F.

Useful Tables and Valuable Information.

Metric Conversion Table

Cubic Metres × 264.2 = Gallons (231 Cu. Ins.)
Litres × 61.022 = Cubic Inches.
Litres × .2642 = Gallons (231 Cu. Ins.)
Litres ÷ 3.78 = Gallons (231 Cu. Ins.)
Litres ÷ 28.316 = Cubic Feet.
Hetcolitres × 3.531 = Cubic Feet.
Hectolitres ÷ 26.42 = Gallons (231 Cu. Ins.)
Grammes Per Cu. Cent. ÷ 27.7 = Lbs. Per Cu. In.
Kilo-grammes × 2.2046 = Pounds.
Millimetres × .03937 = Inches.
Millimetres ÷ 25.4 = Inches.
Centimetres × .3937 = Inches.
Centimetres ÷ 2.54 = Inches.
Metres × 39.37 = Inches.
Metres × 3.281 = Feet..
Metres × 1.094 = Yards.
Kilometres × .621 = Miles.
Kilometres ÷ 1.6093 = Miles.
Kilometres × 3280.7 = Feet.
Square Kilometres × 247.1 = Acres.
Cubic Centimetres ÷ 16.383 = Cu. Inches.
Cubic Metres × 35.315 = Cubic Feet.
Cubic Metres × 1.308 = Cubic Yards.
Kilo-gr. Per Sq. Cent. × 14.223 = Lbs. Per Sq. Inch.
Kilo-gram Metres × 7.233 = Foot Pounds.
Kilo Per Metre × .672 = Lbs. Per Ft.
Kil. Per Cu. Metre × .026 = Lbs. Per Cu. Foot.
Kilo-Watts × 1.34= Horse Power.

The Cost of Pumping

The cost (in dollars) per month (30 days of 24 hours each, of pumping 100 U. S. Gallons per minute against one ft. lift minus the efficiency of Pump and motor together and the cost of power being known.

Rate	Cost		Efficiency of Motor								
(Cents) Kw. Hr.	(Cents) H. P. Hour	Dollars H. P. Year	30	40	50	60	70	76	82	90	91
			Cost per month (30 days 24 hours each) 100 U. S. Gallons per min. against 1 ft. lift.								
0.1	.0007	6.54	.027	.025	.023	.021	.019	.019	.018	.017	.016
0.2	.0015	13.07	.054	.049	.045	.042	.039	.037	.036	.034	.033
0.3	.0022	19.61	.082	.074	.068	.063	.058	.056	.054	.051	.049
0.4	.0030	26.14	.109	.099	.091	.084	.078	.074	.072	.068	.065
0.5	.0037	32.68	.136	.123	.113	.104	.097	.093	.089	.085	.082
0.6	.0045	39.21	.163	.148	.136	.125	.116	.112	.107	.102	.098
0.7	.0052	45.75	.190	.173	.158	.146	.136	.130	.125	.119	.115
0.8	.0060	52.28	.217	.198	.181	.167	.155	.149	.143	.136	.131
0.9	.0067	58.82	.244	.222	.204	.188	.175	.167	.161	.153	.147
1.0	.0075	65.35	.272	.247	.226	.209	.194	.186	.179	.170	.164
1.1	.0082	71.89	.299	.272	.249	.230	.213	.205	.197	.187	.180
1.2	.0090	78.42	.326	.296	.272	.251	.233	.223	.214	.204	.196
1.3	.0097	84.96	.353	.321	.294	.272	.252	.242	.232	.221	.213
1.4	.0104	91.49	.380	.346	.317	.292	.272	.260	.250	.238	.229
1.5	.0112	98.02	.407	.370	.339	.313	.291	.279	.268	.255	.245
1.6	.0119	104.56	.434	.395	.362	.334	.310	.298	.286	.271	.262
1.7	.0127	111.09	.462	.420	.385	.355	.330	.316	.304	.288	.278
1.8	.0134	117.63	.489	.444	.407	.376	.349	.335	.322	.305	.294
1.9	.0142	124.16	.516	.469	.430	.397	.368	.353	.339	.322	.311
2.0	.0149	130.70	.543	.494	.453	.418	.388	.372	.357	.339	.327
2.1	.0157	137.23	.570	.518	.475	.439	.407	.391	.375	.356	.343
2.2	.0164	143.77	.597	.543	.498	.459	.427	.409	.393	.373	.360
2.3	.0172	150.30	.624	.568	.520	.480	.446	.428	.411	.390	.376
2.4	.0179	156.84	.652	.592	.543	.501	.465	.446	.429	.407	.393
2.5	.0187	163.37	.679	.617	.566	.522	.485	.465	.447	.424	.409
2.6	.0194	169.91	.706	.642	.588	.543	.504	.484	.464	.441	.425
2.7	.0201	176.44	.733	.666	.611	.564	.524	.502	.482	.458	.442
2.8	.0209	182.98	.760	.691	.633	.585	.543	.521	.500	.475	.458
2.9	.0216	189.51	.787	.716	.656	.606	.562	.539	.518	.492	.474
3.0	.0224	196.05	.814	.740	.679	.627	.582	.558	.536	.509	.491

Example

To find the cost per month of pumping 12 gallons of water per minute against 75 ft. Head divide 12 (gallons per minute) by 100 and multiply this (.12) by 75 (feet Head) and then by .627 This is obtained by referring to the above table opposite 3c per KW hour (cost of current) and under 60 (efficiency of motor) which equals $5.64.

The following table gives the total plunger load in pounds pressure on a cylinder and well rod with standard sizes of cylinders. Sufficient has been added to the above table to take care of friction of plunger packing and the flowing of water through the connecting pipes or valves.

Table of Plunger Loads in Pounds Pressure.

Combined Head and Lift	Diameter of Cylinders in inches.										
	1¾	2	2¼	2½	2¾	3	3¼	3¾	4	4¼	4¾
25	34	44	56	67	78	98	108	144	163	185	230
50	67	88	112	134	155	196	216	288	326	368	461
75	101	132	156	202	237	276	324	432	491	552	691
100	134	178	224	269	312	367	432	576	653	738	924
125	168	221	281	336	384	461	540	720	817	924	
150	202	267	312	403	462	552	648	864	980		
175	235	300	367	470	540	644	756	1008			
200	269	355	425	538	618	734	864				
225	302	400	508	605	696	828	972				
250	336	444	564	672	774	918					
275	370	488	620	739	852	1013					
300	403	533	677	806	930						
350	470	613	791	941							
400	538	710	850								
450	605	799	1015								
500	672	888									
550	739	977									

Example

If you were using a 3¼″ artesian well cylinder with a combined head and lift of 100 feet, the total plunger load would be 432 pounds pressure.

Useful Tables and Valuable Information

How Much Do Other Liquids Weigh?

The weight of liquids other than water can be obtained by actually weighing on an ordinary small scale a one gallon can, deducting the weight of the can. If a hydrometer is available the information can be obtained by the use of the following tables: The degrees Baume and Twaddle are the markings given on the hydrometer scale. The specific gravity is another way of saying percentage of weight per gallon as compared with the weight of water.

Liquids Lighter Than Water

Degrees Baume	Specific Gravity	Degrees Baume	Specific Gravity	Degrees Baume	Specific Gravity	Degrees Baume	Specific Gravity	Degrees Baume	Specific Gravity	Degrees Baume	Specific Gravity	Degrees Baume	Specific Gravity	Degrees Baume	Specific Gravity	Degrees Baume	Specific Gravity
10	1.000	15	0.966	20	0.933	25	0.903	30	0.875	35	0.849	40	0.824	48	0.787	58	0.745
11	0.993	16	0.959	21	0.927	26	0.897	31	0.870	36	0.843	41	0.819	50	0.778	60	0.737
12	0.986	17	0.952	22	0.921	27	0.892	32	0.864	37	0.838	42	0.814	52	0.769	65	0.718
13	0.979	18	0.946	23	0.915	28	0.886	33	0.859	38	0.833	43	0.805	54	0.761	70	0.700
14	0.972	19	0.940	24	0.909	29	0.881	34	0.854	39	0.828	46	0.796	56	0.753	75	0.683

Liquids Heavier Than Water

Hydrometer Reading Degrees		Specific Gravity	Hydrometer Reading Degrees		Specific Gravity	Hydrometer Reading Degrees		Specific Gravity	Hydrometer Reading Degrees		Specific Gravity
Twaddle	Baume		Twaddle	Baume		Twaddle	Baume		Twaddle	Baume	
0	.0	1.000	20	13.0	1.100	43	25.5	1.215	63	34.6	1.315
1	.7	1.005	21	13.6	1.105	44	26.0	1.220	64	35.0	1.320
2	1.4	1.010	22	14.2	1.110	45	26.4	1.225	65	35.4	1.325
3	2.1	1.015	23	14.9	1.115	46	26.9	1.230	66	35.8	1.330
4	2.7	1.020	24	15.4	1.120	47	27.4	1.235	67	36.2	1.335
5	3.4	1.025	25	16.0	1.125	48	27.9	1.240	68	36.6	1.340
6	4.1	1.030	26	16.5	1.130	49	28.4	1.245	69	37.0	1.345
7	4.7	1.035	27	17.1	1.135	50	28.8	1.250	70	37.4	1.350
8	5.4	1.040	28	17.7	1.140	51	29.3	1.255	71	37.8	1.355
9	6.0	1.045	29	18.3	1.145	52	29.7	1.260	72	38.2	1.360
10	6.7	1.050	30	18.8	1.150	53	30.2	1.265	73	38.6	1.365
11	7.4	1.055	31	19.3	1.155	54	30.6	1.270	74	39.0	1.370
12	8.0	1.060	32	19.8	1.160	55	31.1	1.275	75	39.4	1.375
13	8.7	1.065	33	20.3	1.165	56	31.5	1.280	76	39.8	1.380
14	9.4	1.070	34	20.9	1.170	57	32.0	1.285	77	40.1	1.385
15	10.0	1.075	35	21.4	1.175	58	32.4	1.290	78	40.5	1.390
16	10.6	1.080	36	22.0	1.180	59	32.8	1.295	79	40.8	1.395
17	11.2	1.085	37	22.5	1.185	60	33.3	1.300	80	41.2	1.400
18	11.9	1.090	38	23.0	1.190	61	33.7	1.305	81	41.6	1.405
19	12.4	1.095	39	23.5	1.195	62	34.2	1.310	82	42.0	1.410
			40	24.0	1.200				83	42.3	1.415
			41	24.5	1.205				84	42.7	1.420
			42	25.0	1.210				85	43.1	1.425

Example: To obtain weight of fuel oil testing 15 degrees on a Twaddle Scale hydrometer or 10 degrees on a Baume scale hydrometer, the specific gravity is 1.075 x 8.33 (weight of one gallon of water) = 8.954 lbs. which is the weight of one gallon of this fuel oil.

Practical Suction Lift Table

Water can be raised vertically 22 feet at sea level with a lift or suction pump. Where the lowest level of water in the well is more than 22 feet, a power working head should be used, information covering which is given in Deep Well Pump Bulletin No. 276. The practical suction lift of all pumps is given in bulletins as 20 feet. This will vary for different localities according to following table (your county surveyor can advise you as to number of feet above sea level of your township)

Number of feet above sea level	Practical Suction Lift.
At sea level	22 feet
¼ mile or 1320 feet above sea level	22 feet
½ mile or 2640 feet above sea level	20 feet
¾ mile or 3960 feet above sea level	18 feet
1 mile or 5280 feet above sea level	17 feet
1¼ mile or 6600 feet above sea level	16 feet
1½ mile or 7020 feet above sea level	15 feet
2 mile or 10560 feet above sea level	14 feet

Example· Madison Township is 1200 feet above sea level. H777 Hand or Power Pump should not be placed over 22 feet above lowest level of water in the well.

GARBER PUB. CO., Ashland, Ohio.

FREE ENGINEERING SERVICE
BLANK. IF SOURCE OF WATER SUPPLY IS NOT OVER 20 FEET BELOW THE LEVEL OF THE PUMP.

I am giving below the actual conditions, under which I would like to install a pump if practical. Your giving me detailed data, with recommendations as to size of pump, size of pipe, etc. obligates me in no way whatever.

My supply of water is a______________________________(Well, Cistern, Lake or Spring) (If from well or spring, state capacity with continuous pumping, if this information is available.____________________ gallons per__________)

I will require____________________gallons of water per day of 24 hours. (For tables, giving the amount of water required for ordinary farm homes, see page 5 of this bulletin).

I am inserting those dimensions required in the circles on the drawing on the reverse side of this blank. The delivery pipe is already in, and the pipe size is given on the drawing. (If delivery pipe is not in, leave the circle blank and we will recommend the best size for this use). There are ____________sharp turns or bends in the delivery pipe.

I would like to install pump___________________ feet away from the supply of water. It will be necessary to have___________________elbows or bends in the suction pipe of the pump.

I want the pump to deliver water at the spout only ______________ (Yes or No)

I intend pumping into an open tank or reservoir________________ (Yes or No)

The water to be pumped is clear ______________ (Yes or No) (If water is not clear, state whether gritty, acid, alkiline, hot or cold _________________.)

I want to operate the pump

By hand________________________(Yes or No)

By windmill _____________________(Yes or No)

By pump jack _____________________(Yes or No)

By electric motor ____________(Yes or No) Direct Current:_______ Volts

Alternating Current:__________ Volts

_____________Cycles ___Phase

Quote on motor_________(Yes or No)

By_________________engine. (Gas, gasoline, or kerosene)

Quote on engine (_________Yes or No)

If you already have motor or engine, give _______________Horse power, Size of belt pulley_______________inches wide___________inches in diameter

Revolutions of belt pulley_______________per minute.

FOR A HYDRO-PNEUMATIC (Air and Water) SYSTEM, FILL IN THE FOLLOWING:

I would like to maintain from________________pounds to ______________pounds pressure in the pneumatic tank. (The usual pressure for medium size systems is from 30 to 50 pounds. If you are in doubt as to this, leave blank and we will make our recommendations from the data given above.)

I would like to have pump operate automatically _______________(Yes or No) (An automatic pump will stop the motor when a certain high pressure is reached, and start the motor when the lowest pressure is reached. If used in connection with a gasoline engine, it will automatically stop but not start the engine.)

My name (Please Print)____

Street Address, R. F. D. No. or Box No.______________________________

Town ______________________State ______________________

Name of my pump dealer _____________________________________

Address of pump dealer____

Town ______________________State ______________________

It would be helpful and much clearer if a rough sketch showing location of buildings and well or pond were attached to this Free Service Blank.

Please be certain that you have filled in dimensions in circles on diagram on opposite side.

Go——

to the Dealer That Displays This Sign

No matter what kind of a pump you need, the HUMPHRYES' DEALER in your locality can supply it. He can furnish you with the latest and most practical style of hand pump—power pump—or complete water supply system. He is equipped to give you expert advice and help in choosing the right pump for your particular need.

The Humphryes Manufacturing Co
Mansfield Ohio U.S.A.